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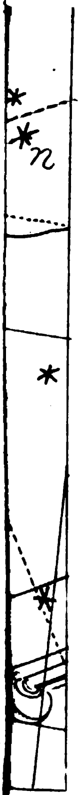

AN

ASTRONOMICAL CATECHISM;

OR,

DIALOGUES

BETWEEN

A MOTHER AND HER DAUGHTER.

ILLUSTRATED WITH NUMEROUS ENGRAVINGS.

By CATHERINE VALE WHITWELL.

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PREFACE.

When we reflect on the present state of society, and contemplate the energy employed in drawing into exercise the various faculties of the human mind, the delight arising from the consideration that so much has been achieved, may sometimes lead to the exclamation, What yet remains to be done! To the hasty traveller the spacious building may appear complete; though to the attentive examiner many defects will be seen in this edifice, however grand.

The love of literature is, it is true, on the advance; but the symptoms of superficial attainments are also prevalent. Education is highly prized, but it is too often an education, which excites momentary admiration, without yielding lasting respect, or procuring solid advantage.

To prevent this, no pains should be spared. The selection of popular truths from sciences the most profound, so that with ease they may be wrought into the youthful mind, forms one barrier against those temptations to display and vanity, which unavoidably present themselves to the youth of either sex.

Stimulated by this idea, I have carefully inquired for all elementary books connected with the subject of Astronomy, and am obliged to confess that I have found but one in all respects calculated to become an introduction to this sublime science; and that is the interesting volume of Bonnycastle. Ferguson's work is, indeed, most valuable; but since Bonnycastle appears to have selected much that is important from this author, and to have given it a modern dress, the advantages of that work are now in some degree superseded.

But, notwithstanding the high merit of Bonnycastle, his work is too extensive to be committed to memory; and, as it is written in a fluent and connected manner, to select detached passages would destroy the beauty and consistency of the whole. The examination of pupils from the contents of this work, in a connected series of questions and answers, at first suggested the idea of the benefit that might arise from an Astronomical Catechism.

Intimately connected with one important division in astronomy, is the mythology of the heathen world. I have, therefore, also collected a number of the mythological works, usually put into the hands of young people. From the publication of Tooke's Pantheon, to that of Miss Hatfield's delicate, interesting, and recent production, perhaps few have escaped my perusal. But since at a very early period of life it was my unparalleled happiness to read Mr. Bryant's ample and masterly performance, it is not wonderful that the facts he has brought together, and displayed in his inestimable pages, make it obvious to me that another volume is yet wanted for the perusal of the youthful inquirer. Grecian fables may indeed be clothed most delicately, but they remain fables still. It is indispensable, that at an early period of life, the fallacy of all this beauty, of all this Grecian vivacity should be seen through, that the child should be taught to inquire what is the FOUNDATION on which this *pleasing* superstructure stands. Deeply impressed with this idea, I have asserted, and I hope proved, that the Greeks seized upon a sphere formed by other hands, relative to more ancient, and more important transactions; that they retained the constellations on our globe, but misapplied or new-modelled historical facts to their own fabulous mythology. Mr. Maurice's varied, yet unique productions, are treasures of inestimable worth; but it is obvious, that they are altogether unsuitable to be the common class-books of young persons at school. The vast and varied quantity of information they contain, the consequent bulk of the volumes, and the necessary expense attending their purchase, place them on a shelf not to be found in a school girl's library. Therefore, should this trifling production have only the one happy consequence of forming in the minds of my pupils the fixed resolution of hereafter reading the works of Mr. Bryant, and of Mr. Maurice, the end, in its consecration to their service, will be answered. Even within these walls, a death-blow to infidelity will be given in the mind of each individual, who makes this one resolve. For to read these inestimable works, and to remain unconvinced of the divine origin of our holy religion, is impossible; nor is this most important effect achieved by argumentation, but by an accumulation of the most astonishing body of evidence, the evidence derived from well-authenticated FACTS.

The dialogue mode of instruction has, I am aware, its disadvantages, as well as conveniencies. Some superfluous language will necessarily occur, unessential to instruction; but it possesses considerable advantages, in awakening the curiosity, and keeping up the attention, of the juvenile mind. Should it be thought that the Daughter, in the present series of dialogues, *occasionally* discovers in her questions and replies too much quickness, and too extensive an acquaintance with a difficult and intricate science; let it be recollected, that it is better to make a small sacrifice of probability, than to leave any considerable chasms in the discussion of an important subject; that quickness of attention and promptitude of reply are, in a great degree, the creatures of habit; that the daughter in the Dialogues is an ideal personage, who is supposed to have been under regular instruction, affectionately and assiduously imparted, which has combined in the gradual developement, and improvement of her mental powers.

Russell Square,
Sept. 29, 1818.

AN

Astronomical Catechism.

PART THE FIRST.

CHAPTER I.

INTRODUCTION.

What is astronomy?

Astronomy is that branch of natural philosophy which treats of the heavenly bodies. It teaches their magnitudes, motions, distances, periods, eclipses, and order.

But is not this a subject far too complex to be rendered interesting to me, or to any one so young as I am?

Before we proceed one step, I will promise to require no more than that ordinary measure of attention, which must be rendered to any art, or science, in which you would excel. With this measure of attention I cannot dispense; but having this, I am sure you will be so charmed with the fascinating and important character of the facts I have to communicate, that before the period of your education is completed, you will request me to add a companion to this solitary volume.

But still is this not a science in which a vast multitude of mathematical calculations are necessary?

In an attention to plane or pure astronomy, which includes only the determination of the magnitudes, distances, and the orbits of the heavenly bodies, such calculations are indispensably necessary; but in those interesting facts, in those capital truths, which I shall lay before you, such calculations are not necessary.

Is astronomy, then, a science so comprehensive, that it may be divided into several parts?

Into three parts it may certainly be divided; viz. into plane, physical, and historical.

You have told me what I am to understand by plane or pure astronomy: will you inform me what is meant by physical astronomy?

Physical astronomy comprehends the investigation and the explanation of the causes of the motions of the heavenly bodies; so that, while in pure astronomy, discoveries are made by observations on the apparent magnitudes and motions of the heavenly bodies, in physical astronomy those principles and laws of motion, by which bodies on and near the earth are governed, are applied to the other bodies in the system.

This is rather more than I can comprehend; but as these are subjects, to which I am not at present to attend, I doubt not but the division reserved for me will be much more simple. May I inquire what I am to understand by the historical part of astronomy?

You will find, that under this general title I shall direct your attention to the rise and progress of this science, to its uses, to some interesting particulars respecting the sun, the earth, and the moon, to the planets, their satellites, to comets, to the starry heavens, and to the constellations in general: and I cannot express to you the anxiety I feel, that this branch of science may early occupy your most serious attention.

But why are you particularly anxious, that I should be well acquainted with this part of astronomy?

So many are its uses, that I will give you a distinct chapter on that subject; but I have an object dearer to my heart than reputation, or health, or station, or life: it is, that believing you live in a wicked world, you may also admit that there is in this world an entire remedy, a complete antidote for all the sorrows, for all the miseries, for all the wickedness, that exist. This remedy, this antidote, is the Bible; I wish you, therefore, to have recourse to it as the great physician, as the pearl of immense price, as the infallible guide; to seize it as the thing most necessary, most valuable, most indispensable; as the only medicine that begins to operate exactly where the malady of man commences, namely, in the heart.

And will the history of astronomy help me to see this?

I do not say it will; but the Mosaic history, it will wonderfully corroborate, and consequently all that the Bible contains; for between the Old and New Testament, there exists an indispensable bond of union. I wish the parts of this inestimable volume to be interwoven with all your studies, that each of its divisions being endeared to you, the whole may be infinitely precious. Let it acquire this measure of value during your youth, and as the world with all its necessities, unfold themselves to your view, the Bible with all its sufficiency, will be ready to answer your every demand.

CHAPTER II.

ON THE RISE AND PROGRESS OF ASTRONOMY.

Were not the Greeks the first people who studied astronomy?

No; certainly not.

Who, then, were they?

The Chaldeans.

How do you know that the Chaldeans were the first people who studied astronomy?

Because astronomy was so essential to husbandry, that the country which first became the residence of mankind after the flood, must have been the parent of astronomy; and that country was Chaldea.

But I seem to have imbibed a firm idea, though I can scarcely tell how, that to the Greeks we are indebted for all that we have, connected with astronomy.

I am not much surprised at that, and your mind is at present unprepared to receive all I have to communicate on that subject; but in a future chapter, I trust I shall succeed in convincing you that the Greeks, and the Egyptians, both claim an antiquity which belongs alone to the Chaldeans. There can be no doubt that there existed a more ancient sphere, than the Grecian, or Egyptian, allusive to an older race, and to a different mythology.

Then when I look on the celestial globe, do I see the sphere formed by the Chaldeans?

That is too much to believe; since, if the original sphere be not totally lost, it must have been considerably altered, by the prevalence, in Asia, of the Arabian, and, in Europe, of the Grecian, system of astronomy. I will give you the words of the indefatigable Mr. Maurice on this subject: he says, " In truth I consider the sphere of which we are in possession as the work of astronomers of many distinct nations of the East, combining various circumstances of their respective mythology, and united into one mass, as well as appropriated to themselves by those of Greece, from whom it has descended down to posterity."

Did the Greeks then derive their knowledge of astronomy from the Chaldeans?

No, not immediately, but from the Egyptians. To Egypt, according to their own confession, the immortal band of Grecian philosophers resorted, and amidst the colleges of Thebes, and Heliopolis, drank deeply of this pure fountain of celestial science.

You mentioned to me just now, the Arabian system of astronomy: from what people did they derive it?

From the Grecians, at a period comparatively recent.

And are those, that you have mentioned to me, the principal nations that have cultivated this science?

No: among the Phœnicians, the Persians, and the Indians, it was carried to a great extent. But we need not hesitate in pronouncing Chaldea the parent of astronomy: the knowledge here acquired must have spread itself on every side, as the people migrated; but, when they became stationary, as in India, in Egypt, or in Persia, the local peculiarities, the prevailing habits of the people, would mark themselves in their progress in this science.

Will you tell me who were Musæus, Atlas, and Chiron?

Three Grecian philosophers, who observed the heavenly bodies, and made some faint essays towards the formation of a sphere. Chiron formed a broad circle representing the seasons, and marked down such stars as were particularly useful in agriculture.

At what period did these persons flourish?

About fourteen hundred years before Christ.

I suppose astronomy must have rapidly improved, when men ventured to embark on the mighty ocean?

This certainly must have been the case; yet how little was known to the Greeks, 'tis obvious from the circumstance of only five constellations being mentioned by Hesiod.

When did Hesiod write?

About nine hundred years before Christ.

Which are the constellations he names?

The Hyades and the Pleiades, Sirius, Orion, and Arcturus.

But was not Homer a more distinguished poet than Hesiod? How many does he mention?

A proper inquiry, since he did not live at a period very remote. He adds, however, but two; which proves that even in his time the catalogue was inconsiderable.

Which are those two?

Boötes and the great Bear.

When I look at the little Bear, whose name shall I associate with it, as having formed those stars into a constellation?

You may associate with it the name of Thales, in whose time astronomy began to be cultivated as a regular science in Greece; for, if he were not the inventor, it is certain he first brought it into Europe.

Did the Greeks at that early period unite as much fable with their astronomy, as they did with the other sciences?

Yes; as a specimen I will tell you, that there was among them, one, who paid great attention to those nightly changes in the moon which you witness; and from this simple fact arose the fiction, of the planet being quite in love with the man.

He must, I think, have been pleased with this: what was his name?

Endymion; and because Atreus paid equal attention to the revolution of the sun, they invented a story about that orb's going back, at the entertainment which he gave to his brother.

Who was the first Grecian that travelled into Egypt?

Thales.

At what period?

About six hundred years before Christ.

Did he remain in Egypt, or return to Greece?

He returned to his native country with his mind richly furnished with all the treasures of Egyptian learning, but peculiarly so with astronomical information.

Would you object to giving me some examples of the great attainments of this philosopher?

He was able to measure with exactness, the vast height and extent of a pyramid, merely by its shadow. Water he regarded as the grand principle of every thing. He calculated with accuracy a solar eclipse. He taught the Greeks the true time of the equinoxes, and recommended the division of the year into 365 days. It is also asserted, that he was the inventor of the five imaginary zones that bind the celestial sphere. He was the founder of the Ionic sect.

I hope from this school, some pupils came forth, worthy of so great a master.

Yes, several: Anaximander, one of them, was not inferior to his preceptor in his love of astronomy.

When did he flourish?

In the year 568 before Christ.

What did he teach respecting the earth?

He asserted that it was of a cylindrical form, and situated in the centre of the system.

Did he think of any thing that manifested as much astronomical information, as the division of the globe into five zones, by Thales?

The invention of the gnomon is ascribed to him, though it is probable he only brought it from Babylon, and made use of it in marking the tropics, and equinoxes.

Is the gnomon, then, an astronomical instrument?

A gnomon is the hand or pin of a dial. The gnomon of every dial is supposed to represent the axis of the earth, and therefore the two ends or extremities must directly answer to the north and south pole.

Did he make any other discoveries?

Yes; he discovered the obliquity of the ecliptic.

Will you tell me something about the other pupils of Thales?

I do not know that that is necessary, but I will give you some information respecting the great philosopher Pythagoras, who entered this world, at about the period Anaximander was quitting it.

At what period was that?

Five hundred and forty-seven years before Christ.

Did this philosopher also go into Egypt?

Yes; but not till after he had spent the years of his youth, in the most diligent exertions at the academy at Samos. From thence he returned to Sidon, his native place, where he was initiated into all the mysterious rites and sciences of Phœnicia.

And then did he go into Egypt?

Yes: and, under a severity of discipline not easy to be described, he continued the prosecution of his studies, for the additional period of twenty-two years.

This brought him, it may be supposed, beyond the age of forty: so much study was, I hope, of use to him?

He received a reward much greater, I apprehend, than he expected. For you must understand that the Indians, Chinese, and Persians, the Egyptians and Greeks, preserved the most profound secrecy on all religious matters. That no stranger or person of inferior rank should comprehend their mysteries, there were not only the ordinary barriers, of midnight gloom, secrecy, and difficulty of access, but they also used double language, and cultivated a twofold doctrine, one for the regulation of the great mass of the community, which was called external; the other understood only by the priesthood, and called internal. Of the facts connected with this subject, one of the most interesting with which I am acquainted, I will this evening read to you *.

The question I am going to propose is not astronomical, but may I ask, is that the way clergymen preach to us? Do they say one thing from the pulpit, and another when they converse alone? Does the Bible employ one kind of language for the priest, and another for the people?

No; the plan of the Bible is altogether different, and I know not a more satisfactory evidence of the divine origin of our holy religion, than that it destroys in man (in exact proportion as it infuses its holiness into his character) that vile love of self, which where it is not known, universally prevails. In fact, Christianity introduces the human character to us under an aspect altogether new. Instead of the self-deified, and egoistic misanthrope, whose greatness consists in a studied reserve, whose authority arises from the dark and subtle artifices of despotism; we see a noble disinterestedness, in which no personal consideration has weight, but as it is subservient to the benefit of mankind. You behold the children of this heaven-born family, when you look at a Howard, a Brainerd, a Buchanan, a Brown, a Thompson, a Corie. But to return to Pythagoras.

---

* Memorandum I.

Will you tell me what unexpected reward he had for his long study?

Yes; the Egyptian priests were so much astonished and delighted at the severity of his application to learning, that they waved their established rule of secrecy to strangers, and unfolded to him all their mysteries, and all their sciences.

And did he then go back to Greece to instruct his own people?

No. He had heard of the Chaldean, and Persian Magi, and the renowned Brachmanes of India, and he was impatient to explore the hallowed caves of the former, and the consecrated forests of the latter.

And did he visit these places?

He did, and thereby greatly enlarged his measure of information, besides enjoying again a very unexpected remuneration for all his toils.

What was that?

In Chaldea he was not only received with delight, by the Magi in general; but the prophet Ezekiel, and the second Zoroaster, were there at the same time.

How long did he stop here?

Twelve years. From thence he visited India, where he continued a considerable time, and then he returned to Greece.

It will really be interesting to know, if he communicated to the Greeks any grand astronomical facts, after so long a peregrination?

Yes, he did. He was the first who taught them the *true astronomical system,* and placed the sun in the centre. And the importance of his latter journeys will appear, when I inform you, he must have gained this information in consequence of that; for, in Egypt, the true system was not known for four hundred years after.

If he taught them the true system, he informed them, that the planets go round the sun?

It is probable that he had not a very clear idea on the subject, but still a considerable step was taken; the motion of the planets was observed, and Venus, though only remarked by Homer, on account of its beauty, was now discovered to move in a circular orbit. The period, respecting which I am speaking, was about 550 years before Christ; but I am anxious, that you should observe, in proof of there having existed, somewhere in Asia, a set of people much more advanced in astronomy than the Grecians, that Isaiah* had spoken of this planet as the morning star two hundred years before, and he was consequently acquainted with its revolution, at that distant period. I wish to say a word to you about Plato, though not before I have thought of some link, by which I may unite him to what goes before.

---

* Isai. xiv. 12. Isaiah flourished B. C. 757.

Can you not by some means unite him to Thales? for you told me, he had many pupils.

Well, then, Thales had a pupil named Archelaus, who became the master of Socrates; and the latter was the guide and preceptor of Plato.

When was Plato born?

About 430 years before Christ.

Did Plato travel?

Yes; but his travels were the result of his tutor's condemnation and death. To abate the agony of his mind, he went first into Italy, and then over the whole of Egypt.

And did he come back as wise as Pythagoras?

Perhaps as wise as Pythagoras was when he left Egypt; but, you will recollect, that Pythagoras returned to Greece from India.

Then there was some difference in the mental acquirements of these great men?

Plato was indeed an eminent mathematician, and metaphysician; but it is as true, as it is astonishing, that this learned man embraced the system of astronomy, since called the Ptolemaic, in preference to that known by the name of the Pythagorean.

What is the difference of these two systems?

The Pythagorean, as I before mentioned, places the sun in the centre of the system. But the Ptolemaic places the earth immoveably in the centre; while the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, are made to revolve round him in the order here mentioned.

And was the true system discredited in consequence of the opinion of Plato?

In some degree this was the case, but not entirely so; for Philolaus, who flourished 374 years before Christ, clearly, and successfully, taught the true system.

Who formed the signs of the zodiac?

Cleostratus, who flourished about this period. It was not long after this, that Meton introduced the famous lunar cycle of 19 years.

What do you mean by the lunar cycle?

It is a grand revolution of the moon, in which period the new and full moons, the conjunctions, and lunar aspects, fall on the days, exactly corresponding with those, on which they took place 19 years before.

In consequence of some observations you have already made, may I inquire, whether the cycle was really the invention of Meton, or whether he derived it from Chaldea?

He borrowed it from Chaldea.

You just now told me that Cleostratus form-

ed the signs of the zodiac; but at that time had not the Greeks divided the heavens into the constellations, which I see represented in the northern and southern hemispheres?

No; this division was formed about 360 years before Christ, by Eudoxus, who brought a sphere from Egypt, accommodated it to the Grecian history and mythology, and surpassed all his predecessors in devotion to astronomy.

But since his devotion to astronomy was so great, is it not possible that he formed the sphere himself?

No; he did not form it himself; for, if he had, all the constellations would have been farther advanced by half a sign than they are described to be in his writings; so that it was probably derived from one more ancient, perhaps from that of Chiron the Centaur.

Who was Chiron the Centaur?

I shall show you presently, that he was no less a personage than Noah, though concealed beneath a form, half human, and half bestial.

Did Eudoxus evince his love for astronomy by any other effort?

Yes; he was the first, who in Greece assigned its position to the equinoctial colure; and I wish you to remark, we have now advanced forward only two centuries, from the return of Pythagoras from India. How wonderful, then, is the progress of the Grecians! The ancient history of their most illustrious families, during the poetical ages, might be read in the heavens; and such had been the diligence of this ingenious people, that it appeared as if astronomy, with all its ramifications, was their own invention.

Was astronomy then more successfully cultivated in Greece than in Egypt?

No; not after the period respecting which we are speaking; for about three centuries before Christ, the patronage of the Ptolemies, raised the Alexandrian school, to a wonderful pitch of eminence.

I have heard you speak of a catalogue of the fixed stars. Was there such a thing existing at this time?

The appearance of a new star in the heavens, in the time of Hipparchus, induced him to undertake so astonishing an enterprise, as that of numbering the stars, and marking the situation of each, that posterity might discern what changes take place.

And have changes, since that time, rendered the catalogue of Hipparchus valuable?

Yes, highly so; as I shall prove to you hereafter.

How many stars did he introduce into his catalogue?

One thousand and twenty-two; and to each he annexed the latitude, and longitude, it had at that time.

Did Hipparchus make any other discoveries?

Yes; he ascertanied that the interval between the vernal, and autumnal equinox, is 186 days, that is, seven days longer than between the autumnal and the vernal.

What is the cause of this difference?

The eccentricity of the earth's orbit. He also discovered that slow motion of the stars from east to west, which is now denominated the precession of the equinoxes.

You have already mentioned to me the Ptolemaic system. How was the individual distinguished, whose name this system bears?

He is distinguished by having been an indefatigable collector, and recorder, of the opinions of others, and a most diligent observer of the heavens.

When did he flourish?

In the first century of the Christian æra.

Will you not tell me a little more about the Ptolemaic system?

It is, I believe, only necessary that I should add, that, above the planets before mentioned to you, he placed the firmament of fixed stars, the crystalline orbs, the primum mobile, and the heaven of heavens, all which, according to his belief, revolved round the earth in 24 hours, and also in certain periodical times, agreeably to their annual changes.

And what opinion do you form of this system?

It must, notwithstanding the erroneous principles upon which it is founded, be considered a wonderful proof of human genius and exertion.

Did Ptolemy make any important discoveries?

No: but he completed and improved the catalogue of fixed stars begun by Hipparchus; and he ascertained that the equinox proceeds at the rate of one degree in one hundred years.

Since Ptolemy was a faithful collector of the opinions of others, has he any observations, which may confirm the idea that our sphere is originally Chaldean?

In his work he asserts, that Hipparchus collected all the accounts of eclipses which he could meet with among the Babylonians, and all their celestial observations. Being preserved by Ptolemy, they were handed down unimpaired to us; so that from Hipparchus, through the care of Ptolemy, we are in possession of the Chaldean astronomy, and our sphere is, in point of fact, not Egyptian, but Chaldean.

Who was the next person that distinguished himself by his attention to astronomy?

From the time of Ptolemy, to the period when his valuable work, consisting of the labours and discoveries of all his predecessors, was translated from Greek into Arabic, a long and gloomy interval of nearly 700 years elapsed, without one material improvement being made in this noble science, either in the schools of Egypt, or Greece. Since the respectable list of ancient astronomers terminated with Ptolemy, we will discontinue our inquiries for the present, and this protracted conversation, itself shall find a close.

CHAPTER III.

A CONTINUATION OF THE SAME SUBJECT.

May I renew our conversation by inquiring, what circumstances led to a revived attention to astronomy?

But will it not be interesting to you, first to learn, what could have occasioned the neglect of such a delightful subject?

Yes; that would be very agreeable.

Well, then, you must call to mind the fact, that at the period during which astronomy was neglected, a remarkable revolution was taking place in the world. Rome, the mistress of all nations, the sovereign arbitress of the fates of men, was hurled from her exalted pinnacle.

I have read, that the Roman empire had become too extensive to be guided by one hand, however powerful that hand might be.

That is true; but the hand which held the reins of government, was not strong, as it had been; it was become weak, through the luxury and effeminacy of those, who were once all manliness to defend the cause at home, all energy to support her dignity abroad.

Perhaps then it was this obvious love of ease *among the Romans, that encouraged the barbarians to make their attack?*

This certainly was not overlooked by them, and the martial spirit, and irresistible impetuosity of the Ostrogoths, and Visigoths, of the Huns, Saxons, and Franks, form an astonishing contrast with the timid policy, the delicate refinements, and the divided opinions, of the now, degenerate Romans.

But, of course, while you speak well of these barbarians, as being fine-spirited men, you surely think they did great injury to science?

Of this there can be but little doubt: for, though the Romans were sunk to the lowest state of national degradation, and therefore were not qualified to illustrate to their invaders the advantages of their laws, their arts, their literature, and sciences; yet, even if they had, perhaps the barbarians were too ignorant, rightly to have appreciated them; and their desolating fury, produced a revolution too much like an overwhelming torrent, to allow of the revival of the old Roman spirit, or the melioration of barbarian impetuosity. In consequence, indeed, of the extinction of freedom, the old Roman spirit had, in fact, completely evaporated.

Then it is to this sudden change in the state of the world, that I am to ascribe the neglect of astronomy?

Yes; and now we may proceed to its revival.

That was, I suppose, a very slow process?

Slow indeed, at first; but, during this general convulsion, science retired to its original source, and in the sixth century we find astronomy made a favourite object of pursuit at Bagdad, near to ancient Babylon. During the reign of Almansoor, a Mohammedan prince, the writings of Ptolemy were translated into Arabic. Astronomy was assiduously cultivated, throughout Arabia, and Persia, and in different districts of Tartary; it became the delight of princes, and the companion of the great and the noble.

And how did it find its way to this side of the Mediterranean?

In the ninth century, the Arabians carried their arms and their sciences into Spain; and in the thirteenth century, the works of Ptolemy were translated into Latin.

After astronomy had been fairly introduced into Europe, was it long before it was attended to in England?

No; the flame of devotion to this goddess was now kindled, and it soon spread, and blazed, in almost every kingdom of the western world. Roger Bacon was the first Englishman, whose astronomical attainments excited the wonder, of a neighbouring nation, and whose knowledge called forth the jealousy, of his associates at home.

What neighbouring nation? what jealousy?

At the university of Paris he was regarded as a prodigy of learning, and not without reason; for, among a multitude of attainments, he understood the use, and manufacture, of convex and concave glasses, and laid the foundation for the discovery of the telescope by Galileo. But you are prepared to admit, that he lived on the confines of midnight darkness; hence, his associates, represented to the multitude, that he maintained intercourse with infernal agents. Under this ridiculous pretence he was restrained from reading lectures; his writings were not allowed a wider circulation than the walls of the convent; and, finally, when he had reached the age of 64, he was imprisoned in his cell, where he continued twelve years.

Did Roger Bacon adopt the Ptolemaic system?

There can be little doubt of that, since it was all that his utmost diligence could effect to read what Ptolemy had collected. Under his circumstances, to have struck into a new path, would have been almost impossible; for you may observe, since the Ptolemaic compilations had been conveyed to Bagdad, since they had been studied there, under the patronage of a powerful race of Caliphs, since they had been translated into Arabic, cherished in Arabia, Persia, and Tartary, brought into Spain, translated into Latin, and received into every kingdom in Europe, this error had now taken a deep root, and a very extensive range, and was firmly wrought into the minds of men.

Certainly; and the removal of this prejudice must have been attended with considerable difficulty?

Yes; with more than it is possible for any youthful mind to conceive: for, in support of this universal error, it was thought, that several passages of the Bible lent their aid, and, as more light broke in upon the inquiring mind, there was difficulty in uniting faith and theory.

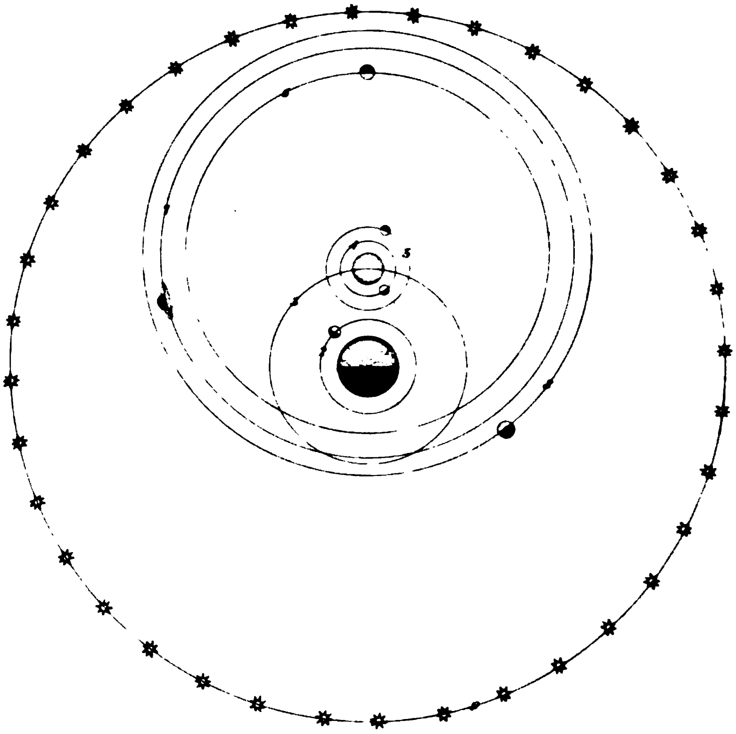
Did any one attempt to do so?

Yes; Tycho Brahe, who flourished in the latter end of the sixteenth century. His mathematical acquirements were considerable, and he was too well acquainted with the motions of the heavenly bodies to suppose their centre to be any where but in the sun. He was struck with the beauty, simplicity, and harmony, of the Pythagorean system, which was brought before his view by Copernicus. He, however, was perplexed with certain passages of Scripture, and the result of the whole was the invention of a most ingenious system.

What was that?

His objects were two: the one, to allow the earth to remain fixed in the centre of the system;

The Tychonic System.



1 Earth. 2 Moon. 3 Sun. 4 Mercury. 5 Venus. 6 Mars.
7 Jupiter. 8 Saturn. 9 Firmament of the Fixed Stars.

the other, to cause the planets to move round the sun. This was difficult, but this drawing will illustrate to you his idea of the earth being quiescent in the centre, and of the sun and planets being carried about it in a year, while these, by their proper motions, revolve round the sun in their several periods.

This was certainly very clever; but will you tell me if there really is any thing in the Bible which ought to have puzzled him?

I dare say I could refer you to at least two dozen passages which intimate that the sun rises and sets *, and consequently seem to imply that the earth is stationary; but when we recollect that that inestimable book, is given us, simply as a guide by which we are to regulate our conduct, and not as a chart illustrative of astronomical investigations; that the language used was in conformity to the apprehensions and opinions of those to whom it was addressed; that it was not intended to raise in their minds speculations unsuitable at the moment of discourse, all difficulties connected with this point immediately vanish.

Did Tycho Brahe do any thing more for the astronomical world than what you have told me?

He discovered the truth of what Hipparchus had suspected nearly two thousand years before, that the fixed stars are subject to remarkable changes.

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* Memorandum II.

How came he to discover this?

In his time a new star appeared in the Chair of Cassiopeia, which, after having shone for some months, with such splendour that it was visible in the daytime, faded away gradually, and at length became invisible.

Can you give me an instance of any thing similar?

On the 10th of October 1604, the scholars of Kepler discovered a new star in the right leg of Serpentarius.—It was very brilliant at first, then suffered a gradual diminution of light, and totally disappeared about the beginning of January 1606.

In the neck of the Whale, the star marked *o*, is discovered to have a periodical change of brightness.

Three changeable stars have been observed in the neck of the Swan: the first is near to the star marked γ, the next is marked χ, the third has been seen near the head of the Swan.

The star Algol, in Medusa's Head, appears of different magnitudes, at different times.

The bright stars, Sirius and Arcturus, have been observed to change their places by moving towards the south, about two or three minutes of a degree in a century; and the stars, Aldebaran, and Aquila, have also a like motion, but somewhat slower, and less easy to be determined.

All these changes have, I hope, made some good astronomers imitate the conduct of Hipparchus, and form another catalogue of the stars?

This has been the case; Tycho Brahe was the first who followed his example; his catalogue contained the places of 777 stars, rectified to the beginning of the year 1600.

I hope the ingenious system of Tycho Brahe was of some use in overturning the Ptolemaic system, and in introducing the true system of the universe?

Religious bigotry on the one hand, and philosophical pride on the other, were hard things with which to contend; and this Copernicus saw so clearly, that, though he had fully adopted the Pythagorean system, and afterwards published it to the world, with new and demonstrative arguments in its favour, yet he suppressed his book for more than thirty-six years.

Has not Bonnycastle somewhere described the heroism of Copernicus?

Yes; I will read to you the passage:—"Seized with a daring enthusiasm, he laid his hands on the cycles and crystal orbs of Ptolemy, and dashed them to pieces; and with the same noble frenzy, he took the unwieldy earth, and sent her far from the centre of the system, to move round the sun with the rest of the planets; so that, of all the celestial equipage with which she had been formerly dignified, there only remained the moon to attend and accompany her in her journey." This is admirable! and Sir John Pringle, in his Discourses addressed to the Royal Society, observes, "At the appointed time, when it pleased the Supreme Dispenser of every good to restore light to a bewildered world, and more particularly to manifest his wisdom in the simplicity, as well as in the grandeur of his works, he opened the glorious scene with a revival of sound astronomy, and raised up Copernicus to dispel the darkness in which it was then involved." But we must proceed, and I will introduce to you one of the greatest men that ever yet appeared on the globe; greater than Hipparchus, or Ptolemy, than Tycho Brahe, or even Copernicus himself; for these were all indebted, for a considerable part of their knowledge, to the Chaldeans, the Hindoos, and the Egyptians; but Kepler, by his own talents, and industry, made discoveries of which no traces are to be found in the annals of antiquity.

Will you oblige me with one illustration?

The orbits of the heavenly bodies had always been supposed to be circular; their conjunctions, oppositions, and other mutual situations, not returning again in the same time, and their distances from the sun, appearing to be greater, and less, in the different stages of their progress, were sufficient to indicate, that their orbits were elliptical: but it required the mind of a Kepler to perceive, that all motion is naturally performed in straight lines, and that, when a body moves in any regular curve, it must be acted upon by two forces, one which sets it in motion, and another which opposes this motion and changes its direction; and that, by the union of these two forces, the former, called the centrifugal force, and the latter, named the centripetal force, all the planets are maintained, and move in their respective orbits.

From this it is evident, that Kepler defended the Copernican system?

He did so.

I wish you would give me a little more explanation of these two forces.

By centrifugal force, is understood, that force by which any revolving body endeavours to fly off from the centre of motion, in a tangent to the circle which it describes; and by centripetal force, that force by which any revolving body is made to tend towards the centre of its orbit.

This great man also happily conceived, that there might be some proportion between the times of the revolutions of the planets and their distances from the sun; and he found that attraction varies reciprocally as the squares of the distance; so that at double a given distance there is a quarter the force exerted, at half the distance, four times the strength, which must necessarily influence the revolution of the planets.

The stars in each constellation are, I see, marked with a letter of the Greek alphabet.—Whose thought was that?

It was the suggestion of John Bayer, a native of Germany, who first introduced it into his charts in the year 1603.

Were there any further steps which led to a rapid improvement in astronomical information?

The accidental discovery of the magnifying power of a convex, and a concave glass, when suitably adjusted, and the happy use made of them by Galileo, were circumstances of considerable importance. He gradually increased the powers of this instrument; till, from magnifying only three times, he produced one which magnified objects a thousand fold.

Surely a new scene must now have presented itself to the eyes of the astronomer?

Yes; and a scene as astonishing as it was new. Venus presented an appearance resembling the phases of the moon, and hence it might be inferred, that the earth also had a daily motion. The four satellites of Jupiter were observed attending that planet, and hence it appeared probable that the moon accompanied the earth during her annual journey. Hills and valleys were discovered in the moon, and hence the difference between the earth and these heavenly bodies appeared likely not to be so great as had been inculcated, and imagined.

Have succeeding astronomers been satisfied with the degree of perfection to which Galileo brought his glasses?

O no: tubes of stupendous magnitude, of almost unmanageable length, and capable of magnifying an object to an amazing degree, have been the result of great zeal in the cause, and of great attention to the subject.

Who are the persons who have distinguished themselves by their careful construction of telescopes, and by their exposure to the cold midnight air?

In the middle of the seventeenth century, Huygens and Cassini stood deservedly conspicuous; and we rejoice that in the present day the munificence of our venerable Sovereign has enabled our great Herschel to give full scope to his rare genius.

But you have not said one word to me about an astronomer whose name I have often heard you mention, that is, Sir Isaac Newton.

But I am willing to say, as much as you will like to hear: where shall I begin?

I should like to know when he lived, and for what he was distinguished.

He was born A.D. 1642, and died in 1726. He seems to have been endowed with superior faculties, in order to dissipate the mists of ignorance and error, which clouded the minds of men: sagacity, penetration, energy of mind, diligence, modesty, and love of retirement, marked him during the whole progress of his life.

Will you oblige me with one or two facts as illustrations?

Though the reading of Euclid, forms the boundary of mathematical attainments of a multitude of students, it was scarcely the study of one week to Newton. Exempt from the gradual process necessary to mankind in general, he advanced at once into the higher fields of geometry, and, before he was two-and-twenty years of age, he had laid the foundation of his two immortal works, his Principia and his Optics.

O, how I should like to read them!

How different is this observation from the fear which you expressed upon a former occasion!

But do not now think of that; tell me more respecting this wonderful man.

I shall take peculiar pleasure in exhibiting to you some instances, which will more fully illustrate those properties of his exalted mind, which I have already enumerated.

In the very rapid survey which we have this morning taken of the progress of astronomy, you may, I think, see light breaking through darkness, and order rising out of confusion; but, still, comparatively, little had been effected. The ignorant, unsettled, timid, and proud world, needed a guide, pre-eminent in wisdom, and in inflexibility; one who could surmount the predilections of his own heart, and rise above the prejudices of others: and all this was found in Newton; for he imposed upon himself two great maxims, from which he did not deviate:—first, never to shrink from a doctrine which had evidence on its side; and secondly, never to admit any doctrine when this evidence was wanting.

I will endeavour to remember these two maxims.

But mark what I say: they are only requisite in astronomy, but necessary in divinity: of commanding importance, when you read the lectures of Newton; and indispensable, when you read the precepts of Jesus Christ.

Do you think, mamma, that the Newtonian system, cannot be destroyed by any philosopher who shall hereafter arise?

That is impossible; it must remain unshaken while the present frame of nature continues in existence.

From what you have said, I think I can *gather, that Sir Isaac Newton confirmed, and indeed established, the Copernican system?*

He did so. The laws of gravitation and attraction, which he saw operating on the earth, he applied to the heavenly bodies; he solved the problem of Kepler, to which I have adverted; he discovered the composition of light; and revealed all the secrets, and removed all the difficulties attending the movements of the watery world. In consequence of the peculiar character of his mind, a mind like which, in force and in humility, in firmness and in modesty, perhaps never before lighted upon our globe; the whole circle of sciences was enriched; algebra, geometry, mechanics, optics, chronology, philosophy, and astronomy, all shone forth with new lustre; and they were presented by him to the world with augmented dignity and resistless importance. In fact, he did all that the period allotted to human life would allow him to do. Nothing less than the revolution of a considerable period of time, with the constant use of instruments of increased power, could have accomplished more.

Happy for us, we live in a day when Herschel is known; his stupendous glasses have excited our admiration, his discoveries have warmed our hearts from time to time, and with renewed emotion we have inquired

" At what fix'd point in space, Jehovah dropp'd
His slacken'd line, and laid his balance by,
Weigh'd worlds, and measur'd infinite no more;
Where rear'd his terminating pillar high, and said,
I stand, the plan's proud period; I pronounce
The work accomplish'd, the creation clos'd."

CHAPTER IV.

ON THE USE OF ASTRONOMY.

You told me, mamma, you would favour me with a distinct conversation on the uses of astronomy. Can you not do so to-day?

You are aware, that some of these uses have incidentally developed themselves; but I see no objection to presenting them to you in a collected form, that you may, at one view, cast your eye on them, and thus the more easily retain them in your memory. What has been said will, however, enable you to assist me in making the arrangement. How shall we begin?

I will mention one of which I have been thinking.—It appears to me, that an attention to astronomy must greatly improve the mind, by adding to the force and penetration of the human understanding; and that not simply by exposing a number of interesting truths to view, but by banishing a multitude of superstitious opinions and vain fears. Of this I should not perhaps have thought, had I not heard some persons, from their ignorance of astronomy, express their fears at the appearance of a comet; and I was this morning reading an account of the practices of *the superstitious Hindoos at the time of an eclipse.*

You may read it, if you please.

"*An eclipse happened in the year* 1666.—*Bernier was then at Delhi; and upon the day on which it happened, ascended the terrace of his house, which was situated near the bank of the Jumnah; whence he beheld an innumerable crowd assembled on either side of the sloping banks of that river, standing in the water as high as the girdle, demurely looking up to the sky, for the purpose of plunging into the stream the instant that they should perceive the eclipse commence from the dreadful assault of the celestial dragon. In this great and motley assemblage, people of all ages and degrees promiscuously mingled, from the venerable Brahmin, bending beneath the weight of age, to the child of six years old; and from the exalted Rajah to the meanest mechanic. When, at length, that eclipse began, they all raised a mighty outcry, and the whole multitude at once plunged entirely into the water; and this immersion they repeated several times; then standing upright in the water, devoutly lifting up their hands and eyes to heaven, muttering certain prayers all the while with great fervour, from time to time taking water in their hands which they threw up towards the sun, bowing down their heads very low, and moving and twisting their arms and hands in an hundred* *different directions; they continued these apish tricks to the very end of the eclipse, when every one throwing a piece of silver to some distance into the water, and giving alms to the Brahmins who attended, they retired, leaving their old apparel behind them, and putting on new vestments, which they had previously brought, and which lay carefully folded up on the adjoining sand. Upon all the sacred rivers throughout Hindostan, he describes the same crowds as assembled, and the same complex ceremonies as taking place. And not only on the rivers these rites took place, but at the various tanks or reservoirs of sacred water, particularly at the venerated cistern of Tannasar, where were collected together no fewer than one hundred and fifty thousand worshippers."*

Your reading brings to my mind another use of astronomy, which is, that astrology is effectually eradicated by the principles of this science. We do not explore the heavens for the sake of pretending to become acquainted with the benign and malignant influences of the heavenly bodies, of unravelling the hidden events of futurity, nor to burden our memories with a catalogue of the guardian genii of the planets, or with the heaven-born sovereigns, as innumerable as the stars they govern; but for the purposes of enlarging our minds, of increasing our information, and of multiplying our comforts.

Will you enumerate some of its other uses?

It is indispensable to the husbandman and the mariner; indispensable in historical records and in religious worship; and indispensable in geography as well as in navigation. I have not, indeed, yet said enough to show you the vast importance of astronomy to those who formerly ventured on the trackless ocean, and the no less trackless deserts of Arabia, and Africa. The stars in the Great Bear were alike the guide of the vessel, and the wagon, of the pilot, and the wagoner. I have introduced the words "historical records;" and should wish to observe, that the deeper we penetrate into the records of antiquity, the more and more we are obliged to see that very distant æras are solely the records of astronomy; that the fictitious story of Osiris or Noah, marching over, subduing, and fertilising the earth, and instructing its various inhabitants in the arts of husbandry, and in the principles of civilization, was principally to be understood of the sun, performing round the globe his annual apparent revolution, warming and fertilizing, as well as illuminating and invigorating in his progress, its different regions; and that, in the constellations, is to be read a considerable part of the history, theological and civil, of the ancient world. Hence I am insensibly led to think of another use of astronomy.

Do not only think of, but mention it, my dear mamma.

It certainly forms an important link between the puzzling mythology, and complex chronology of the ancients, and the simple history and modest chronology of the Bible. It concentrates the scattered rays that diverge from these sources of information, rendering the former more intelligible, by removing the glare cast around it, and the latter more precious, since, from every ordeal, it rises afresh with unrivalled perfection, and with unborrowed beauty.

Will you oblige me with a few illustrations of the use of astronomy, in chronological calculations?

A passage from Newton's Chronology of ancient Kingdoms will incontestably prove this. "From the circumstance of Chiron having fixed the position of the solsticial and equinoctial points in the year 939, and from Meton having observed, in the year of Nabonassar 316, that the summer solstice was then in the eighth degree of Cancer, he has, by a retrogressive calculation, been enabled to fix with precision, the æra of the Argonautic expedition. This argument is thus formed: during the interval which elapsed between the celestial observations made by these two ancient astronomers, the solstices had, he remarked, goes back 7 degrees. Now, the solstice recedes one degree in about seventy-two years, and 7 degrees in five hundred and four years. By counting these years back from the year of Nabonassor, the result will be, that the Argonautic expedition took place about nine hundred and thirty-six years before Christ."

Again: "In Egypt, the heliacal rising of Sirius, with which the year anciently began, marks the period of the commencement of the Egyptian empire; for by retrogressive computation, as well as from the calendar preserved by Ptolemy, we find, that Sirius rose heliacally in Egypt, two thousand years before the birth of Jesus Christ, and therefore the probable inference is, that Egypt flourished four thousand years ago; a fact agreeable to history, and greatly corroborated by the monuments of its grandeur yet remaining. By the same retrogressive calculation, regulated by the precession of the equinoxes, at the rate of seventy-two years to a degree, it may be ascertained, that to the inhabitants of Chaldea, the Pleiades rose heliacally, or, in other words, that the vernal sun was in the first degree of Taurus, about the period of the deluge. Thus it was under the favourable rising of those stars, which by heathen writers are observed to have been so friendly to all mariners, that the ark of Noah commenced its voyage on the waters, which overspread the earth; and perhaps it was owing to this circumstance of the universal inundation taking place when the sun was in the sign of Taurus, that the bull was an object of general distinction and veneration." Thus it appears, that astronomy furnishes a certain and invariable standard in the measurement of time.

Are there any additional uses attending the study of astronomy?

Yes; when we reflect on the thousand times ten thousand worlds, all in motion, yet calm, regular, and harmonious, it affords the most exalted ideas of God and of his works.

> "The Lord of all, himself through all diffus'd,
> Sustains, and is the life of all that lives.
> Nature is but a name for an effect
> Whose cause is God. He feeds the secret fires
> By which the mighty process is maintain'd.
> He sleeps not, is not weary, in whose sight
> Slow circling ages are as transient days.
> His work is without labour, his designs
> No flaw deforms, no difficulty thwarts,
> And whose beneficence no change exhausts."

But this is not all: astronomy corroborates the Mosaic records, which detail the events of the first ages of the world.

Not only are the constellations in the northern hemisphere of great importance in this respect, but those, also, delineated on the southern hemisphere, are a most interesting commentary upon the ten first chapters of Genesis. So that I do hope astronomy will be found subservient to the noblest purposes, and I trust I shall be able to collect within the narrow compass of this short series of conversations, truths of primary importance, as they evidently form a part of the basis of the religion of the Bible.

CHAPTER V.

OF THE SUN.

We have, my dear child, in our former conversations traced out the rise and progress of astronomy, and have ascertained many of its uses. I have endeavoured to prepossess your mind in favour of the Copernican system, which consists of the sun, seven primary, fourteen secondary planets, and comets. We will now direct our attention to each of these, beginning with those pre-eminently interesting to us; the sun, the earth, and the moon.

The sun, you have told me, is the centre of the system, round which the planets revolve. The sun, I suppose, is nearly in the shape of an orange?

Yes; but why do you ask me that?

Because the sun always looks to me like a flat circle.

If I wish to express to you the true form of an orange on this paper, which is a flat surface, how should I perform it?

You would draw the outline, throw in the shadows, and then colour it.

Look at those globes on the sideboard, which

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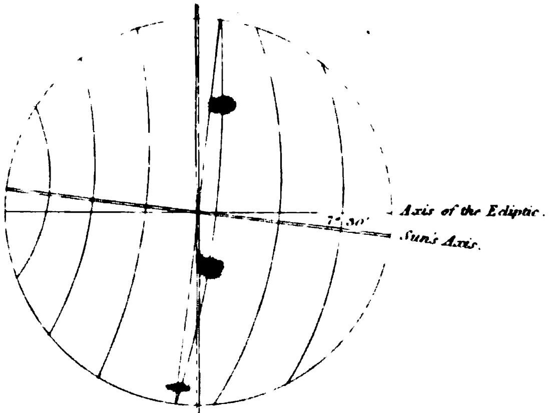

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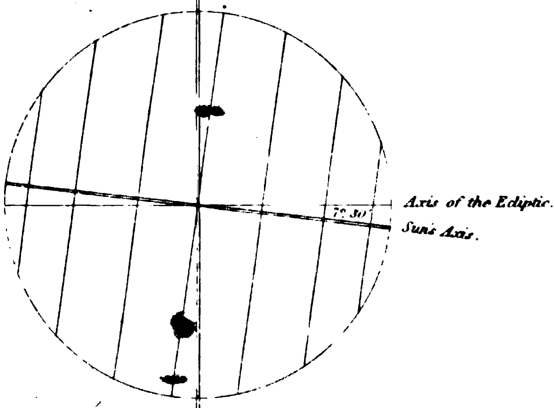

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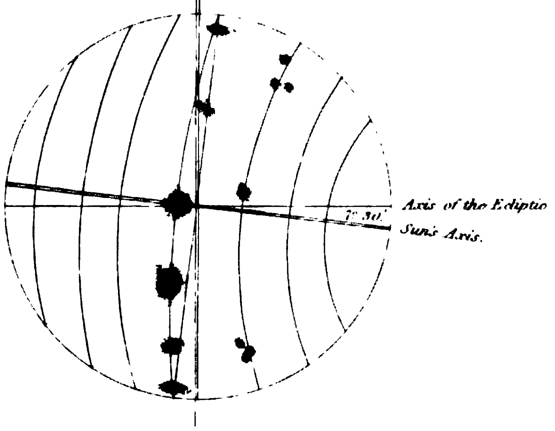

C.V. Whitwell delt

J. Cross sculpt

faces the windows: why do they appear of a spherical form?

Because the light falls on the most prominent parts of the globes, leaving the other parts more or less in shadow.

Now, observe what I say: when a globular body is near enough to appear of its true figure, this appearance is owing to the light, and shadow being both obvious. But when a body is almost all luminous, or when it is removed to such a distance, that these distinctions are not observable, the sphere no longer appears of its true shape, but looks like a flat circle; thus it is with the sun; it appears to us like a bright flat circle, which flat circle is termed the sun's disk. That the sun is of a spherical form, you will not doubt when I inform you, that it turns around its axis in rather more than twenty-five days.

The distance of the sun seems so inaccessibly great, that I should like to know, how this motion has been ascertained.

The proportional mean distance of the earth from the sun, is one hundred thousand miles, of which immense distance you will be able to form a more adequate idea, when I tell you that its diameter is eight hundred and ninety thousand miles, while the diameter of the earth is not more than seven thousand nine hundred and seventy miles; so that the sun is about one million three hundred and ninety-two thousand five hundred times larger than the earth; the number of solid miles of which it consists, are three hundred and sixty-nine thousand, one hundred and twenty-one billions of solid miles; and hence it follows, that its distance must be extremely great, since it appears not much larger than the moon, but, notwithstanding this, its rotation on its axis is capable of proof.

I long to hear how.

By the motion of a certain number of dark spots on its surface, and these are found to have a motion from east to west; and their quicker motion, when they are at the centre than when they are near the edge, evinces that the sun is a spherical body, that he turns on his axis in a contrary direction, or from west to east, that he is twenty-five days in performing this revolution, and that his axis is inclined to the plane of the ecliptic, seven degrees and a half.

Do these spots, through succeeding revolutions, always present the same aspect?

No, far from it: the spots are sometimes of a comparatively moderate size, while at other times a single spot has been seen much larger than the circumference of the whole earth; and they are so changeable in their situation and figure, as frequently to vary, even during the time of observation.

Have these spots any effect on the sun's light?

It is probable, they have. The page of history informs us, that there have been periods, when the sun has been deficient in its accustomed measure of brightness, and has shone with a dim light for the space of a year. This might be the effect of the magnitude, or number, of these spots, though the cause at the time might not be known.

What number of spots have been seen at once?

About the time, when they were first observed by Galileo, in 1611, forty, or fifty, of them were seen at a time, but at present we seldom observe more than thirty, and there have been periods of seven or eight years, in which none could be discerned.

What you say leads me to suppose, then, that there must be an appearance, and a disappearance of these spots, totally different from that which arises from the rotation of the sun on its axis, which creates a movement from east to west.

That there certainly is, and at the disappearance of a dark spot it is generally converted into an illuminated fæcula, or luminous spot, which appears much brighter than the other parts of the sun.

Of what do these spots consist?

Of a nucleus, or central part, which appears to be much darker than the rest, and to be surrounded by a kind of mist or smoke.

What causes are supposed to produce these spots?

Some philosophers have been of opinion, that they are occasioned by the smoke, and opaque matter, thrown out by volcanoes, or burning mountains of immense magnitude; and that, when the eruption is nearly ended, and the smoke dissipated, the flames are exposed, and assume the appearance of luminous spots. Others have supposed them to be occasioned by a number of planets, circulating round the sun, at a small distance from its surface; and others, that they are clouds, floating near its surface. The opinions of M. de la Hire, Dr. Alexander Wilson, Mr. King, and Sir William Herschel, are interesting.

What was the opinion of M. de la Hire?

The sun he imagined to be in a continual state of fusion, and that the spots, which we observe, are only the eminences of large masses of opaque matter, which by the irregular agitation of the fluid, sometimes swim upon the surface, and at other times sink, and disappear.

What has Dr. Alexander Wilson, of Glasgow, attempted to prove?

That these spots are excavations in the luminous matter, that environs the sun's body, and which is probably of no great depth.

What were Mr. King's sentiments?

In 1788, this gentleman published a dissertation on the sun, in which he advanced the opinion, that the real body of the sun is less than its apparent diameter; that we never discern the real body of the sun, except when we see its spots; that the sun is inhabited as well as the earth, and is not necessarily subject to burning heat; and that there is in reality no violent elementary heat essentially existing in the rays of the sun themselves, but that they produce heat only, when they come in contact with the planetary bodies.

But what is the opinion of Sir William Herschel?

He supposes the solar spots to be the opaque ground or body of the sun, and that the luminous part is an atmosphere, which being intercepted, or broken, gives us a view of the sun himself.

Do the ancients appear to have had any notion of these spots in the sun?

They generally consider it to be a body of pure fire.

Will you tell me, my dear mamma, how you understand the account given of the creation of the sun in the book of Genesis. I read, God said on the first day, " Let there be light, and there was light;" and on the fourth day, " God said, Let there be light in the firmament of the heaven, to divide the day from the night."

It appears probable, that the particles of which the sun is composed were the first day's work, and that the concentration of them into one body, was the work of the fourth day.

There is a very interesting fact, which was first observed by Mr. Childrey, about the year 1650, with which I should wish you to be acquainted.

What is that?

It is what is termed the zodiacal light, first so called by Cassini, in 1683, and by him described in the following manner: "This light accompanies the sun, and is usually attributed to his atmosphere. It is seen at some seasons of the year, either a little after sunset, or a little before sunrise. It appears at first sight like a faint, whitish zone of light, resembling the milky way. Its borders are then ill defined, and scarcely to be distinguished from the twilight, which is seen commencing near the horizon. As it ascends above the horizon, it becomes brighter, and larger, to a certain point, after which the approach of day renders it gradually less apparent, till it becomes quite invisible. The direction of its longer apparent axis, is observed to be in the plane of the sun's equator, but its length is subject to great variation, so that the distance of its summit from the sun varies from 45° to 120°."

CHAPTER VI.

OF THE FIGURE AND MOTION OF THE EARTH.

Of the general questions, which respect the earth, some must be allowed to occupy their appropriate places among the rest of the planets; but I wish now to direct your attention to two topics, respecting the earth, namely, its figure and motion.

In a former lecture, mamma, you told me, that Anaximander asserted that the form of the earth was cylindrical. Who was it that discovered the earth to be spherical?

It is not known, but the doctrine is of great antiquity.

Will you show me, that the doctrine is of great antiquity?

At the taking of Babylon by Alexander the Great, eclipses were found to have been set down, and computed for many centuries, which, without a knowledge of the globular figure of the earth, could not have been known.

Can you give me another instance?

Thales, the Milesian, who lived about six hundred years before Christ, was acquainted with this fact.

But though this fact was known to some *philosophers, are there not many proofs, that this knowledge was confined to a very few persons?*

Yes; some of the greatest poets, and mathematicians, were ignorant of it. Heraclitus, a Greek philosopher, who lived about five hundred years before Christ, thought the earth was in the form of a canoe.

What did Aristotle think?

That it was in the form of a timbrel.

And what was the opinion entertained by most persons respecting the figure of the earth?

It was supposed to be a large circular plane.

But what really is the form of the earth?

The earth is of a round or spherical figure, nearly resembling a globe.

Will you mention to me one evidence of the earth being a round body?

The voyages of Sir Francis Drake, Lord Anson, and Cook, who set out at different times, and by steering almost continually westward, arrived at the places from whence they departed.

Can you give me another proof or two?

The circular appearance of the earth itself, and the loss of the view of the lower part of a vessel, before the upper part disappears; which must arise from the water between the beholder and the vessel, having the form of a curve. The circular shadow of the earth upon the face of the moon, in the time of a lunar eclipse, evinces the form of the earth; besides which, from observations on the other heavenly bodies, its figure might be gathered from analogy.

But are not the hills and valleys upon its surface, irregularities sufficient to destroy its roundness?

No: the highest mountains, with which we are acquainted, bear a less proportion to the whole bulk of the earth, than the small risings on the coat of an orange bear to that fruit. The irregularities on the face of the moon, do not, we perceive, operate to destroy its roundness; for though it abounds with hills, and valleys, it still retains its spherical form.

You would, you said, speak to me a little about the motion of the earth, and I am glad of that, since what you have suid concerning the Copernican system has puzzled me; for the sun and stars certainly do appear to move. I, therefore, wish to know what objections there are to an admission of the reality of their motion?

To suppose that the stars move round the earth, would require a swiftness of motion, which is altogether incredible.

How swift would that motion be?

Such is the distance of the stars from the earth, and consequently such is the extent of the orbits which they would have to run round, that the nearest of them would move more than one hundred thousand miles in a minute.

But, however decisive this may be, is there no other objection to the admission of the motion of those bodies round the earth?

Yes; the bulk of the heavenly bodies, compared with that of the earth, is a considerable objection.

How much larger is the sun, or are the stars, than the earth?

The sun is a million of times larger than the earth, and many of the stars are at least equally large.

To what then might we compare the motion of the sun round the earth?

"To the motion of a millstone round a marble." Are you satisfied?

But, mamma, while these are some of the objections to admitting the motion of the celestial bodies round the earth, are there any arguments in favour of attributing this motion to the earth?

Yes; such a motion will best account for all the celestial appearances, and at the same time preserves that beautiful simplicity and harmony, which is found to prevail in every other part of the creation.

But, if the earth moves, how is it that we do not perceive its motion?

We must remember that the earth is a very large body; and that the air, and all the things upon its surface, move with it in open space, where it has no impediment to meet with in its way, to disturb its beautifully even motion.

To what may we compare the earth in its annual progress round the sun?

"To a balloon turning upon its axis, while it floats through the atmosphere."

But I have heard, that, if the earth really moved, a stone dropped from the top of a very high building, would not fall just at the bottom of it, for the building would advance considerably forward during the time of the fall.

This is a mistake; for "it is found by repeated experiments, that, if one body be thrown from another body in motion, the first body will partake of the motion of the second."

Will you be so kind as to illustrate this observation?

"A stone, dropped from the top of a mast, while the ship is under sail, is not left by the vessel, but falls exactly at the foot of the mast; and if a bottle of water should be hung up in a cabin with its neck downwards, it would empty itself drop by drop, into another bottle placed exactly underneath it, though the ship shall have run many feet while each drop was in the air."

By what term is this motion distinguished?

This motion of the earth, which is round its own axis, is called its diurnal, or daily motion.

Is any periodical change produced by this motion?

Yes; the regular return of day and night.

Is the earth subject to any other motion?

To one other, which is called its annual motion.

Can the earth's annual motion be proved in the same way, as its diurnal?

The proofs may be easily gathered from celestial appearances in nearly the same manner as the former. For, as that luminary seems to move round the earth, from east to west in the space of a day, which is really owing to the diurnal revolution of the earth upon its axis, in a contrary direction; so, likewise, it seems to have an annual motion in the heavens, and to rise, and set continually in different parts of them, which is certainly occasioned by the daily motion of the earth in its orbit, or path round the sun, which it completes in the space of a year.

And will the revolutions and appearances of the different planets also prove, that the earth is not the centre of the celestial bodies?

Yes; for it is evident, that wherever the sun be placed, the orbit of Venus surrounds, and encloses him, within itself; and therefore Venus, while she describes this orbit, must really move round the sun.

Will you kindly illustrate the same fact by the motion of another planet?

Yes: Mercury is always found to keep in the neighbourhood of the sun, without ever receding from him so far as Venus. The extreme brightness of this planet, not only proves that it is nearer to the sun, than the other planets, but that it regards the sun as the centre of its motion.

What do you think, mamma, of Mars, Jupiter, Saturn, and the Georgium Sidus?

These planets, being more distant from the sun than the earth, must necessarily include the earth in their orbits; but, from their appearances, it is plain, that the sun, and not the earth, must be the centre of their motions.

What is the conclusion you draw from all this?

That the earth, itself, must likewise move round the sun; for, since it has Mercury, and Venus, on one side nearer the sun, and Mars, Jupiter, Saturn, and the Georgium Sidus, on the other, more remote, it follows from analogy, that, being of the same nature as they are, it must also partake of the same motion.

CHAPTER VII.

OF THE MOON.

Is it possible, that my dear child can behold yon beauteous orb, without feeling an irresistible desire, to know something more respecting its character and influence? Let your tender mind kindle into devotion at such a season as the present, when this delicately beautiful planet is riding in awful majesty on high, attended by a multitude of lesser lights, which appear to follow in her train, or to decorate her path.

You know, mamma, how I love to hear you talk; attention does not tire me, difficulties do not discourage. I will, therefore, by immediately proposing a question to you, evince my anxiety to know more. While we are now looking at the moon, I observe a number of spots; what am I to understand they are?

Unassisted by the telescope, we naturally suppose, they are seas, and continents, mountains, and valleys; but on a more accurate inspection with the telescope we discern immense elevations and depressions, resembling the valleys, and mountains, on our earth.

And do you think, that they do not merely *resemble them, but that they really are valleys and mountains?*

From the appearance of the shadows cast by these spots it is obvious, they are mountains; for in all situations of the moon, the elevated parts cast a triangular shadow in a direction opposite to the sun, while the cavities are always dark on the side next the sun, and illuminated on the opposite one, which is exactly conformable to what we observe of hills, and valleys, on the earth.

Are there any means of determining the height of these elevations?

As the tops of the mountains are considerably elevated above the other parts of the moon's surface, they are frequently illuminated, when they are at a considerable distance from the confines of the enlightened hemisphere; and the result of this circumstance is, that astronomers are enabled to determine their altitude.

And what height are they found?

P. Riccioli observed, that the hill called St. Catherine, was about one sixteenth part of the moon's diameter, and according to his calculation, its height was nearly nine miles, which is much higher than any mountain on the earth.

But you have spoken to me once, or twice, so highly of Sir William Herschel, that I should like to know, what he says of the height of the lunar mountains.

They have, he thinks, been over-rated, and that with a few exceptions the greater part do not exceed half a mile in perpendicular elevation.

Have not volcanoes been discovered in the moon?

Yes; Herschel discovered three, in the dark part of the moon, of which two appeared nearly extinct, whilst the third exhibited an actual eruption of fire, or luminous matter. It appeared to burn with great violence, and might be computed to be about three miles in diameter. The eruption resembled a piece of burning charcoal, covered by a thin coat of white ashes. All the adjacent parts of the volcanic mountain were faintly illuminated by the eruption, and, in proportion to their distance from the crater, became more obscure.

You mentioned the name of St. Catherine, as appropriated to a spot on the moon; is, then, each place of consequence, distinguished by a proper name?

Yes: Riccioli divided the lunar regions among those philosophers and astronomers who have distinguished themselves by advancing the knowledge of the heavens; giving the names of the most celebrated characters, to the largest spots, and those of less eminence to the smallest; and this method is generally followed.

Will you tell me the names, mamma?

Yes: I will give you a list of the principal spots on the moon with a map, by the use of which you will soon know the names of the places on the moon, when you view it through a telescope.

In a former conversation you spoke of the sun's atmosphere. The moon is, I suppose, accommodated in the same manner?

Why do you say accommodated?

Because I understand the atmosphere, which surrounds the earth, is of such amazing advantage to us in disseminating the light of the sun all around, which would otherwise be confined to a stream of light in the direction in which the sun is situated, so that light could only be enjoyed, when the face is turned to the sun. I understand it increases the length of our days, by affording us light some time before the sun rises, and after he sets; that it breaks the powerful rays of the sun into genial warmth, which would otherwise be a stream of heat, and destroy all vegetation.

I am much delighted with your remarks. You can doubtless tell me the height of the atmosphere?

It is, I believe, about fifty miles.

Since you so justly appreciate the value of this fluid mass of matter, which revolves with the earth, and which guards it from external injury, you will be concerned to find that most astronomers are of opinion, that the moon has no atmosphere.

But why do they think so?

Because the fixed stars, at the time of an occultation, disappear instantaneously without any gradual diminution of their light.

And do you think, mamma, that this reason is sufficient to justify the conclusion?

I am willing to believe not, since we find, that the air supplies the lungs, supports fire, conveys sound, diffuses smell, gives rain, wafts ships, and bears up birds; in addition to the advantages you have named; and since, as the bulk of the moon is thirteen times less than that of the earth, her atmosphere must be diminutive in proportion, and may, though invisible to us, exist.

Are the days on the moon of the same length as those on the earth?

No: the inhabitants of the moon have but one day and night in the course of a month; for, on looking at the moon through a telescope, we constantly observe the same face.

Have they much variety in their seasons?

No; the axis of the moon being almost perpendicular to the plane of the ecliptic, she has little or no diversity of seasons.

There is one thing, respecting the moon, which I wish you to make me clearly under-

stand: it is the continual change of figure, to which she is subject.

I have no doubt of success in the attempt. As these changes are always the same, when the moon is at the same distances from the sun, it proves that she receives her light from that luminary; for the moon being enlightened only on that side, which faces the sun, a greater or less quantity of that enlightened part, will be visible according as she is turned towards us; and her figure will consequently appear to vary through the whole of her revolution *.

Do the earth and the moon, journey in exactly the same track?

Nearly so; the moon's orbit being only inclined to the plane of the ecliptic, in an angle of about five degrees: but this deviation occasions what is called the moon's librations.

What are those?

Irregular motions, by which more than the half of that body is exposed to our view; since, when she is below the level of the ecliptic, we look over her, and when she is above the level of the earth's path, we look farther under her. This circumstance occasions a variation in the apparent dimensions of the spots on the lunar disk, and in their distance from the limbs of the moon.

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* Memorandum III.

Are these the only variations to which the spots are apparently subject?

No: when the moon is in, or near opposition, a very remarkable change in its general appearance takes place. The whole disk appears illuminated, and reflects the sun's rays directly on the earth; many of the shadows projected by the eminences on her surface disappear; and, in fact, the change is so great as to render it difficult to recognise many of the spots.

Has the moon two motions, the same as the earth, one round its own axis, another round the earth?

Yes; and this revolution round the earth is performed in a little more than twenty-seven days; and you are aware, that to the inhabitants of the moon the earth appears to revolve about them in exactly the same period of time.

Yes: and you have just told me, that the earth and moon are bodies of the same nature; so I suppose, that, as the moon is capable of reflecting the light received from the sun, the earth is capable of doing the same?

That is a very proper conclusion; and it is a fact that our earth is a moon, to the moon, appearing thirteen times larger to her, than she does to us.

O mamma, what a majestic sight!

At the time of new moon to us, the earth appears to the inhabitants of the moon, full; but, as the moon turns upon its axis only once during a month, and as we have always nearly the same face presented to us, it is evident, that the residents on one half of the lunar world never enjoy the glorious sight of the earth.

I am sure, I should take a journey to the opposite hemisphere, were it my misfortune to live on the unillumined side.

Yes, I hope you would; for I cannot figure to myself an object more interesting than the sight of a globe gliding majestically along the azure vault of heaven, and affording as much light as thirteen of our highly valued moons. Should any of the inhabitants feel as you do, in comparing it with the sun, they may well say,

> " Thou giv'st us his blaze again
> Void of its flame, and shedd'st a softer day."

CHAPTER VIII.

SECTION THE FIRST.

THE SUN, THE EARTH, AND THE MOON.

For the sake of method we have considered these interesting bodies under three divisions; but to see in a more perfect manner the simplicity, and grandeur, of Nature in her designs, and the wisdom, and the simplicity, of her workmanship, we must no longer separate them, but must view them in their collective operation, in their mutual subserviency and dependence, in their combining together to produce one result, one grand and interesting design.. The most astonishing effects are the result of a few simple principles; the same invariable laws, govern alike the indiscernible atom, and the immeasurable body; the single principle of gravitation, pervades the whole universe, and puts every spring, and wheel, of it in motion.

What subject will you first select, mamma, in considering the united influence of the sun, the earth, and the moon?

We will, for a few moments, turn our minds to the pleasing vicissitudes, exhibited in the alternate succession of day, and night, and in the regular return of the seasons. You can, I am sure, tell me in what way these are produced.

Is not the succession of day, and night, occasioned by the uniform rotation of the earth on its axis?

It is; for, as the globe turns regularly round this imaginary line, once in every twenty-four hours, only one half of it can be illuminated at a time. Hence, it is evident, that any particular place will sometimes be turned towards the sun, and sometimes from it; and, being constantly subject to these various positions, it will enjoy a regular return of light and darkness. As long as the place continues in the enlightened hemisphere, it will be day; and when, by the diurnal rotation of the earth, it is carried into the dark hemisphere, it will be night.

In what direction is this motion of the earth on its axis performed?

It is from west to east; and this occasions an apparent motion of the celestial bodies in a contrary direction.—The sun, for instance, seems to make his daily progress through the heavens, from the east towards the west; but this is an optical illusion, arising from the opposite motion of the earth.

If the axis of the earth were perpendicular to the plane of its orbit, should we not have the days, and nights, equal all over the globe?

Yes; for, if this was the case, the boundary of light and darkness would pass through the two poles, and divide each of the small circles, which are parallel to the equator, into two equal parts; and, as the uniform rotation of the earth upon its axis, must occasion every place to describe equal parts of one of these parallel circles in equal times, the days and nights would of course be equal all over the globe, except at the poles, where the sun would neither rise nor set, but remain continually in the horizon.

But, as the axis of the earth is inclined to the plane of its orbit, what is the result?

The result is, that the days lengthen, and shorten, from the equator to the polar circles, every year, the greatest length being six months, the least length being twelve hours; so that there is sometimes no day or night for many revolutions of the earth within the polar circles, and the days and nights are equally long all the year round at the equator, which is always equally cut by the boundary line of light and darkness.

But, during the six months' darkness at the poles, what is the compensation to the inhabitants?

As one half of the ecliptic never sets, and the other never rises, at the poles, the inhabitants would certainly be in darkness during six months, were it not for the intervention of the atmosphere, which occasions the refraction of the sun's rays, and thus imparts light some days sooner, and occasions it to continue some days longer than it would otherwise remain. Again, the sun never goes more than twenty-three degrees and a half below the horizon of the pole, so that the inhabitants have very little dark night; since, with them as well as with us, there is twilight till the sun is eighteen degrees below the horizon.

The Aurora Borealis, which some naturalists suppose to be a magnetic substance, which, gathering and thickening towards the north, sheds a certain light at a distance, is not without its influence in cheering their gloom.

But still, from the subject of our conversation, I apprehend you have left the most important mitigation, of the situation of the polar inhabitants, for me to name.

Well, then, let me hear what it is.

It is their enjoying so much light from the moon; but though I conclude this to be the fact, I do not understand why the absence of the sun secures the visits of the moon.

This I will endeavour to explain to you.—

" The full moon, being always opposite to the sun, can never be seen while the sun is above the horizon, except when the moon falls in the northern half of her orbit; for, whenever any point of the ecliptic rises, the opposite point sets. Therefore, as the sun is above the horizon of the north pole, from the 20th of March, till the 23d of September, it is plain that the moon, when full, being opposite to the sun, must be below the horizon during that half of the year; but when the sun is in the southern half of the ecliptic, he never rises to the north pole; during which half of the year, every full moon happens in some part of the northern half of the ecliptic, which never sets. Consequently, as the polar inhabitants never see the full moon in summer, they have her always in the winter, before, at, and after the full, shining for fourteen of our days and nights; and when the sun is at his greatest depression below the horizon, being then in Capricorn, the moon is at her first quarter in Aries, full in Cancer, at her third quarter in Libra; and as the beginning of Aries is the rising point of the ecliptic, Cancer the highest, and Libra the setting point; the moon rises at her first quarter in Aries, is most elevated above the horizon, and full in Cancer, and sets at the beginning of Libra in her third quarter, having continued visible for fourteen diurnal rotations of the earth. Thus the poles are supplied, one half of the winter-time, with constant moonlight in the sun's absence, and only lose sight of the moon from her third to her first quarter, while she gives but very little light, and could be but of little, and sometimes of no service to them."

But still, lest the idea which I wish to communicate, should be imperfectly conveyed, I will introduce a few additional obervations in the form of a memorandum at the close of our conversation, and this shall be illustrated by a drawing*. But I wish to point out to you in the phenomenon which attends the harvest-moon, the wisdom and beneficence of the Deity, who so orders the course of this luminary, that it bestows more or less light on all the earth, as the several circumstances of its inhabitants require, and as the varying seasons render it serviceable and necessary.

Pray do so, my dear mamma.

Many persons take it for granted, that the moon rises about fifty minutes later every day than on the day that preceded; but this is the case only at the equator, where there is no variety of seasons, where the weather seldom changes, and even then but at stated times, so that moonlight is not necessary for gathering in the produce of the earth. But, at considerable distances from the equator, where the weather, and the seasons, are more uncertain, the autumnal full moon rises very soon after sunset for several evenings together. At the polar circles, where the mild season is of very short duration, the autumnal full moon rises at sunset, from the first to the third quarter; and at the poles, where the sun is for half a year absent, the winter full moons shine constantly without setting, from the first to the third quarter.

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* Memorandum IV.

I think I know the reason of this.

I presume you understand that all these phenomena are owing to the different angles made by the horizon and different parts of the moon's orbit; and that the moon can be full, but once or twice in a year in those parts of her orbit which rise with the least angles, and can never be full, but when she is opposite to the sun; and since the sun is never in Virgo and Libra, excepting in our autumnal months, it is plain that the moon is never full in the opposite signs Pisces and Aries but at that season; and, therefore, we can only have two full moons in the year, which rise so near the time of sunset for a week together, as the horizontal moon and its immediate successor.

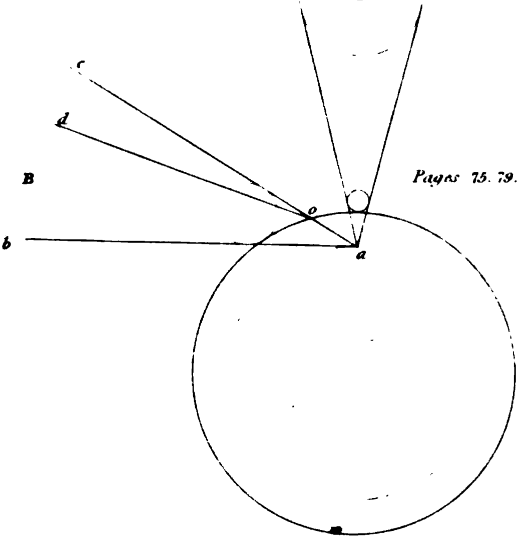
But is not the moon in Aries twelve times in the year?

Yes.

Why then do we not observe this remarkable rising of the moon except at the time of harvest?

The reasons are, in winter these signs rise at noon, when the superior light of the sun prevents her being regarded. In the spring, the

Horizontal Moon



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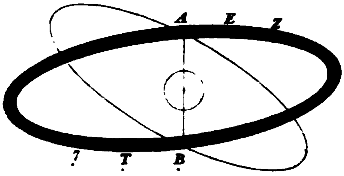

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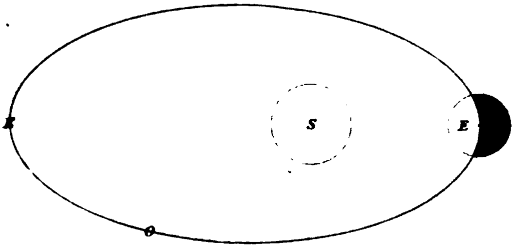

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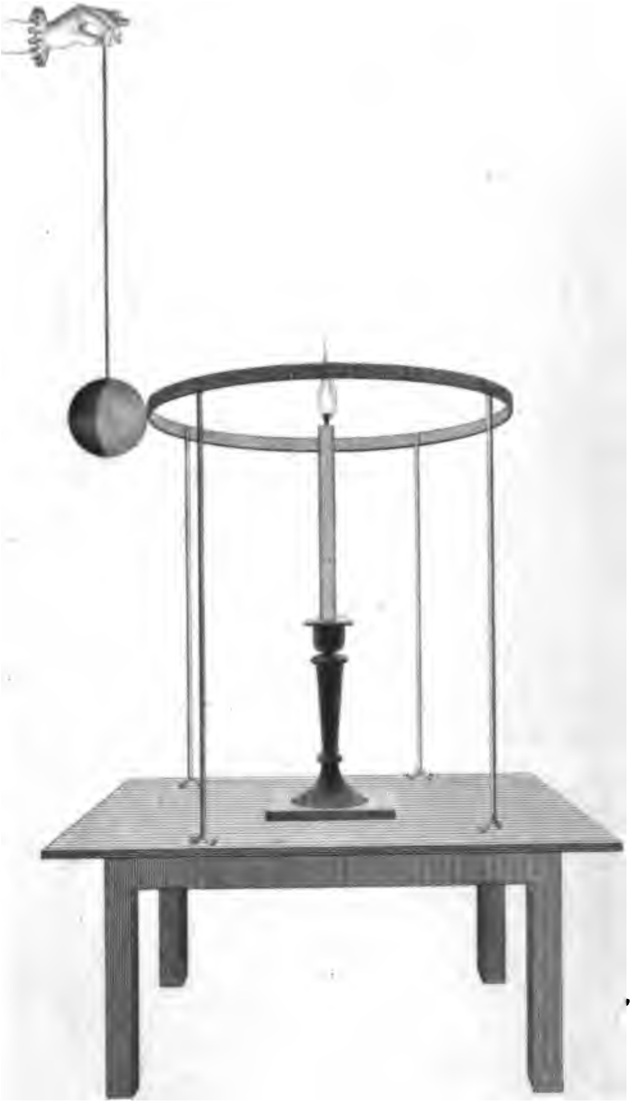
sun is in these signs, and the moon changes in them, so that she is quite invisible. In summer, they rise about midnight, the sun is then three signs before them, the moon is at her third quarter, which, connected with her late rising and the little light she has to communicate, occasions her to pass unobserved: but, in autumn, these signs are opposite to the sun: they rise when he sets, the moon is at the full; which renders her so very conspicuous. That the moon, when thus rising in the east, should appear larger than when she is on the meridian, will be obvious if you attend to this figure and the illustration; though it may seem strange, when we remember, that she is much nearer to us when she is at the meridian, than when she appears in the horizon.

Now you have explained it all so very clearly to me, I certainly think it a very happy circumstance, that she is conspicuous just when she is wanted.

And I think the same; but I cannot allow you to rest here.—We are in great danger of one of two things: either indolently to resign all circumstances to the determination of God, or presumptuously to wrest every thing from the direction of his infinite mind, and to multiply causes, till we think we find a solution to our inquiries; but so it must not be with you. You must most diligently search the book of nature. You must be able to inform me of the mechanism employed there, exhibit to me the acting wheels, and demonstrate how they are placed, between the main spring and the final cause; but, compelled as you will be to see choice, plan, and contrivance; to see difficulties overcome, privations compensated, unnecessary munificence restrained, and favours well timed; you must carry your mind forward to God, the great personal agent who so admirably adjusts the complex machinery. In the present case, we see a process, in which the sun, the earth, and the moon, are the agents employed. By their joint operation there are a set of results the most desirable obtained, and it is improper to indulge in a phraseology, which would ascribe all this to the fortuitous concurrence of circumstances, and not to the actings of a mind, all-qualified to arrange, all-powerful to execute. Having now dwelt sufficiently long upon the diurnal motion of the earth, and upon its result, days and nights, we will proceed to the other grand movement of the earth, which you can describe to me.

It is the earth's annual motion round the sun, which occasions the seasons.

I can, I think, contrive a very satisfactory way of illustrating this.



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Pray do, mamma.

Let a neat little ellipsis be formed of wire, and be made to stand upon four legs, equally delicate, but of unequal heights. Let a candle be placed in the centre, then let an ivory ball, supported by a piece of thread, be twisted towards the left hand, so that, when it untwists, it may go to the eastward, or the right hand, at the same time moving the ball round the wire slowly. The first motion will show the days and nights; the other will display the annual motion of the earth in her orbit. By looking at this, you will also understand, that, if the earth had no annual motion, the sun would never appear to change his place in the ecliptic, and the result would be, that every new moon would fall in the same sign and degree of the ecliptic, and every full moon in the opposite one; for the moon would go exactly round the ecliptic, from change to change.

You mean, that if the moon were once full in Pisces or Aries, she would always be full, when she came to the same sign; but, since the earth has an annual motion, it is otherwise?

The fact is, that, during the time the moon goes round the ecliptic, from the time of any conjunction or opposition, the earth advances almost a sign forward: and, therefore, the sun will seem to go as far forward in that time, namely, 27½°; so that the moon must go twenty-seven degrees and a half more than round, and as much farther as the sun advances in that interval, which is rather more than two degrees, before she can be in conjunction with, or opposite to the sun again. Hence it is evident, that there can be but one conjunction or opposition of the sun and moon in a year, in any part of the ecliptic.

Can you explain this to me by a drawing?

I think my watch will do instead; for what has been said may be illustrated by the hour and minute hands of a watch, which are never in conjunction or opposition in that part of the dial-plate where they were so during the last revolution; and, if we compare the twelve hours on the dial-plate to the twelve signs of the ecliptic, the hour-hand to the sun, and the minute-hand to the moon, we shall have a tolerably near resemblance, in miniature, of the motions of our great celestial luminaries. The only difference is, that while the sun goes once round the ecliptic, the moon makes 12½ conjunctions with him; but while the hour-hand goes round the dial-plate, the minute-hand makes only 11 conjunctions with it; because the minute-hand moves slower in respect to the hour-hand, than the moon does with regard to the sun.

With the form of the earth's orbit you are acquainted.

I have just been reminded of it by the form of that wire; and, I think, you told me before, that Kepler proved it to be elliptical?

I did so. You will readily perceive, then, that the earth must be much nearer to the sun in one part of her path round him, than she is in another.

Yes; I do.

But you will see this to be the case much more clearly, when I have told you, that the sun is not placed in the centre of this ellipsis, which I hold in my hand, but in the lower focus. Here S, represents the sun, O, the orbit or path round the sun, and E, the earth at different times in the year.

This I certainly understand; but, how much nearer is the earth at one part of the year, than she is at another?

Two million, seven hundred, and fifty-four thousand miles.

And which do you think is our situation in winter?

At this letter E.

No, indeed; for as the sun appears constantly larger, or under a greater angle in winter, than in summer, it is evident that the earth must be much nearer to the sun in our northern winter, than in our northern summer. A drawing, which I gave you to illustrate the horizontal moon, may here assist you.

How, then, does it happen, that we have not the hottest weather, when we are at the least distance from the sun?

To obviate this apparent contradiction it may be observed, that the eccentricity of the earth's orbit bears no more proportion to the earth's mean distance from the sun than about one to sixty, and, therefore, can occasion but very little variation of the heat and cold of different seasons. But the principal cause of this difference is, that the sun's rays in winter fall so obliquely upon us, and have so large a portion of the atmosphere to pass through, that they come with less force, and spread over a larger space, than they do in summer, or when the sun is at a greater height above the horizon. In the winter long nights, we have also a greater degree of cold than can be compensated for by the return of heat in the short days; and on both these accounts the cold will be much increased. Whereas in summer, the sun's rays descend more perpendicularly upon us, and therefore fall with a greater force, and in a greater quantity, on any particular place, than when they come to us more obliquely. The sun is also much longer above the horizon in summer than in winter; and, consequently, a greater degree of heat will be imparted by day, than can fly off by night; so that the heat on all these accounts will continue to increase.

SECTION THE SECOND.

We will now proceed to consider the sun, the earth, and the moon, acting in concert, in the production of the tides; but before we enter upon this subject, there is one thought, intimately connected with it, which in so satisfactory a manner illustrates the intervention of a great presiding, and controlling Power, that I should be wrong to omit it. I refer to the proportion of land and water, which the surface of the earth presents. If the water had exceeded its present proportion even but a trifling quantity, compared with the whole globe, all the land would have been covered; had there been much less than there is, there would not have been enough to fertilize the continent.

Do you think the Mosaic account, intimates that the proportion of land, and water, was at first exactly what they now are? does it not rather lead us to suppose, that their being made to balance each other as they do, was a gradual process?

The Mosaic account appears to me to justify the idea, that the present face of the earth, originated from the revolution of the sphere; covered by a surface of a compound mixture, the fluid and the solid parts separating, as the surface became quiescent. But, had the land been left to be the gradual product of the evaporation of the waters, by the solar heat, still, all which I wished to illustrate, remains complete; for, how came the power of the sun to be arrested just at the precise moment, that it was desirable? Why did it not stop sooner? why stop at all? how came it to stop exactly where infinite wisdom pronounced it "very good?"

Certainly; it could only be the result of the will, and the power, of God.

When we estimate the whole mass, of which the globe is composed, there is no doubt, that the solid parts greatly exceed the fluid, yet still the ocean covers more than one half of the surface of the globe, and it was, and is, indispensable, that this large body of water should be kept in continual motion: we will now inquire, how that is effected.

If we had been perched upon a suitable eminence, so that we could have taken a good view of the earth at its first formation, soon after the surface became quiescent, it would have been a nice problem to have found out, how the ocean should be kept in continual motion. If you had not introduced into this Chapter the sun and moon, as companions with the earth, I should never have found it out; but, now I am led to suppose it is effected by their influence.

It is; but we do not look to the sun as the principal source of the tides, since his immense bulk would rather produce one grand elevation, than the alternate ebb, and flow, with which we are now accommodated. Still he is not without his influence, and at the time of the new, and full moon, when the sun and moon act together on the water, they elevate it still more than at another time, and create what are called the spring tides; whilst on the other hand, at the moon's first and last quarters, when the sun and moon act in opposition to each other, the water is less elevated than usual, and the neap tides are produced.

Then I am to understand, that it is to the influence of the sun and moon, that we are indebted for the motion of the waters; but will you tell me why this motion is indispensable?

Winds and currents, aid in producing this effect; but without motion the whole world would become a mass of putrefaction. I think I cannot do better than read you an account Sir Robert Hawkins has given of the cessation of motion in the waters about the islands of the Azores. He says, "In consequence of being becalmed in the year 1590, for the greater part of six months, all the sea became so replenished with several sorts of jellies, and forms of serpents, adders, and snakes, as seemed wonderful: some green, some black, some yellow, some white, some of divers colours, and many of them had life; and some there were a yard and a half, and two yards in length, so that hardly a man could draw a bucket of water clear of some corruption. In this voyage, towards the end, many of every ship fell sick, and began to die apace. But the speedy passage into our country was a remedy to the crazed, and a preservative for those that were not touched." Mr. Boyle also informs us of a friend of his, who was becalmed for twelve or fourteen days in the Indian Sea, who said that the water, for want of motion, began to emit a very offensive smell.

I had attributed our preservation from much of that which you have described, to the saltness of the sea.

The saltness of the sea, has its advantages, by rendering this body of water heavier, and consequently more buoyant, by retarding its congelation, and by furnishing that salt which is used for domestic and culinary purposes; but I trust you see, that the wholesomeness and sweetness of the waters are preserved by their motion.

Yes, I am quite satisfied; but perhaps you will illustrate to me the mode, whereby the moon is the chief agent in the production of the tides.

The waters of the ocean are in continual motion, ebbing and flowing alternately without the least intermission. For instance, if the tide be now at high water mark, in any port or harbour which lies open to the ocean, it will presently subside and flow regularly back for about six hours, when it will be found at low water mark. After this, it will again gradually advance, for six hours, and then return back in the same time, to its former situation, rising and falling alternately twice in about twenty-four hours. The interval between flux and reflux is, however, not precisely six hours, but almost eleven minutes more; so that the time of high water does not always happen at the same hour, but is about three quarters of an hour later every day, for thirty days, when it again recurs as before. Now you will observe that all this exactly answers to the motion of the moon; she rises every day, with a few exceptions, about three quarters of an hour later than upon the preceding day, and by moving in this manner round the earth completes her revolution in about thirty days, and then begins to rise at the same time as before. There is also a constant rotation of the waters from the east, to the west, in exact obedience to their lunar guide. This tendency of the sea towards the west is particularly observable, in all the great straits of the ocean. Such a perfect harmony unavoidably leads us to look to the moon, as the chief cause of the tides. But perhaps you do not discern one difficulty, which opposes itself to what has been said. It is this: the tides occur in the same place, twice in twenty-four hours, whereas the moon is on the meridian but once in twenty-four hours, so that the waters must be raised, both under, and opposite, to her situation.

Now you mention it, it does appear a considerable difficulty; for, though I can understand, that the waters, nearest to the moon, will be raised, I do not see, why the waters, the furthest from the moon, should also rise.

To comprehend this, you will observe, that the part of the earth's waters, which are exposed the least directly to the moon's influence, are the parts which are least attracted by it. You must also remark, that, when the moon is on the opposite side of the earth, all the waters must be attracted by it, in the same direction that the earth itself attracts them, that is, quite through the body of the earth towards the moon herself. Hence those waters, which are farthest from the moon, will have less weight than those of any other part on the same side of the globe, because the moon's attraction, which unites with the earth's attraction, is there least. Now, therefore, the waters furthest from the moon, having less weight, will be pressed on all sides by those, which having more attraction are heavier; and the heavier waters, flowing in, will make them swell and rise in an eminence, directly opposite to that on the other side of the globe, caused by the moon's more immediate influence.

Are the tides the same in all parts of the ocean?

They are highest in the torrid zone.

Can this be accounted for?

The seas, in those parts, are generally deeper, and less affected by changeable winds, or winding shores.

To what height may the waters be raised?

Some of the greatest tides with which we are acquainted, are those in the Severn, and on the coast of Lancashire, and that of the river Indus. The tides are also very high on the coasts of Malacca, in the strait of Sunda, in the Red Sea, at the mouth of the river Saint Laurence, along the coasts of China, and Japan, at Panama, and in the Gulf of Bengal.

There is, I suppose, no place where the waters are quite stagnant?

I know but of one place, that is at Tonquin. In that port there is but one tide, and one ebb, in twenty-four hours; and twice in each month, when the moon is near the equinoctial, there is no tide at all.

Can you explain to me the cause of this?

Sir Isaac Newton asserts, that it arises from the concurrence of two tides, one from the South Sea, and the other from the Indian Ocean. Of each of these tides there come successively two every day, two at one time greater, two at another that are less. The time between the arrival of the two greater, is considered by him as high tide, the time between the two lesser as ebb. Are you aware that there are other tides, besides those belonging to the watery world?

No; where are they?

In the air of our atmosphere: the tides in this element keep time with the moon's motion almost as exactly as do the waters of the ocean.

Were the ancients acquainted with the cause of the tides?

No; they were considered by them as one of the chief mysteries in nature. Aristotle, the great oracle of antiquity, is represented as having thrown himself into the sea, because he was unable to explain its motion.

Pliny, who died A. D. 80, is said to have observed, that there was a similarity in the motion of the moon, and the waters of the ocean. Galileo, and Des Cartes, did not express themselves unphilosophically upon this subject. Kepler conjectured, that attraction was the principal cause, asserting that the sphere of the moon's operation extended to the earth, and drew up its waters.

But after all this I know, who you will introduce to me, as clearing up all obscurities, and as courting difficulties that he might remove them.

And who is that, my child, whom you have learned to praise so warmly?

It is Newton. Bonnycastle says, "to a genius like his, enterprise and discovery were recreation."

If you have not any more questions to propose to me, we will proceed to another topic.

O yes, one: I wish just to know, if the motion of the waters will account for all, or at least most of those changes in the coast, to which the earth is subject?

It will; and are you aware, that the sea is every day making considerable alterations, either by overflowing its shores in one place, or deserting them in others?

Yes; I have read some very interesting facts, which prove that.

Let me hear to what you refer.

"Hubert Thomas asserts, in his description of the country of Liege, that the sea formerly encompassed the city of Tongres, which however is at present thirty-five leagues from it: this assertion he supports by many reasons; and among others, by the iron rings fixed in the walls of the town, for fastening the ships which came into the port. The whole republic of Holland seems, indeed, to be a conquest gained over the sea, and in a manner rescued from its bottom. But, as the sea has been thus known to recede from some lands, it has been found to encroach

upon others, for some countries bear melancholy witness to the fact, and show the tops of their houses and the spires of their steeples still standing at the bottom of the water. One of the most considerable inundations we have met with in history, is that which happened in the reign of Henry the First, which overflowed the estates of Earl Godwin. In the year 1546, *a similar irruption of the sea destroyed an hundred thousand persons in the territory of Dort, and a still greater number round Dullart. In Friezland and Zealand there were more than three hundred villages overwhelmed, and their remains continue still visible at the bottom of the water in a clear day.*"

These are interesting particulars, and they confirm the fact, that the ocean is every day making considerable alterations, either by covering over whole tracts of country, that were cultivated and peopled, at one time; or by leaving its bed to be appropriated to the purposes of vegetation, and to supply a new theatre for human industry, at another.

SECTION THE THIRD.

We will now pass to another subject, in which we shall discern the joint operation of the three bodies, the sun, the earth, and the moon. Perhaps you will recollect asking me, whether the earth, and moon, move in the same orbit round the sun. If this were the case, there would be an eclipse of the sun, at every new moon, and an eclipse of the moon, at every full moon.

But since the path of the sun and moon are not in the same line, I should have thought, there would not have been any eclipses at all. How is it, then, that they are produced?

It arises from the orbit of the moon making an angle of about five degrees, with the plane of the orbit of the earth, and crossing it in two points, called the nodes.

Could you not show me a little drawing, explanatory of the term, Nodes?

Certainly: here is one, which represents two ellipses, one denoting the moon's orbit, and the other the ecliptic, or orbit of the earth. Now at A and B, these ellipses intersect each other, and these precise points are called the moon's nodes. The point, where the moon appears to cross the ecliptic during her passage into north latitude, is denominated her ascending node. While the point in the heavens, at which the moon crosses the ecliptic during her passage into south latitude, is called her descending node *.

Then, when the moon comes exactly to either

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* Memorandum V.

of these nodes, does it certainly produce an eclipse?

Yes, even more frequently than that, because the body of the moon is larger than these precise points; but I will speak of that after I have prepared the way, by explaining to you the cause of an eclipse of the sun, and of the moon.

How kind you are, to answer my wishes rather than my questions! I wish to be wise, but ask questions which impede my progress.

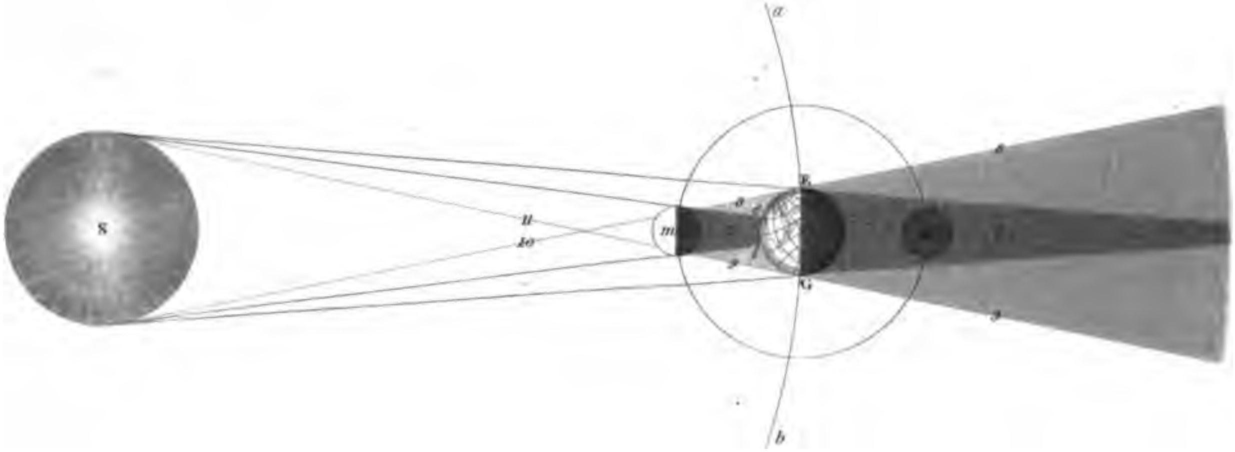
Not exactly so; but to proceed. An eclipse of the sun, is occasioned by the dark body of the moon, passing between the earth, and the sun, or by the shadow of the moon falling on the earth, at the place where the observer is situated: hence all the eclipses of the sun happen at the time of the new moon.

The last drawing answered the end so well, may I beg for another?

There is another; now let S, represent the sun, m, the moon; between the earth and the sun, a E G b, a portion of the moon's orbit; e and l two places on the surface of the earth.

I thank you for this; but what do the parts, in shadow, represent?

That, marked 7, is the moon's shadow, and is called the *umbra*, and the light part the *penumbra;* now it is evident, that, if a spectator is situated in that part of the earth, where the umbra falls, there will be a *total* eclipse of the



a. b. the Earth's Orbit.

C. T. Whitwell del.

J. Cross sculp.

sun at that place; at 8 and 9 in the penumbra there will be a *partial* eclipse, and beyond the penumbra there will be no eclipse at all.

Is it then the fact, that there may be a total eclipse of the sun to the inhabitants of Africa, while to those at the north pole there is no eclipse at all?

Exactly so; for the sun is not deprived of his light during a solar eclipse; and, as the moon's shadow in its passage over the earth from west to east only covers a small part of the earth's enlightened hemisphere at once, your inference is evidently correct.

How much of the earth's enlightened hemisphere, does the shadow cover?

At the moon's least distance from the earth, her dark shadow, covers a circumference of but one hundred and seventy miles, if the time of the eclipse be about noon: but much more if the time be in the morning or evening, because the shadow falls obliquely on the earth. To all, who are within this circumference, the sun will appear totally eclipsed, for about five minutes; but to no place beyond it, although the sun will be partially eclipsed for several hundred miles round.

But, of course, this spot or circumference of darkness journeys on, as the moon which causes it, advances?

Certainly; and it perpetuates the darkness for one hundred and seventy miles during the movement, gradually changing its situation all the time; for the shadow passes like a cloud over the earth, at the rate of two thousand miles an hour.

You said just now, that, at the moon's least distance from the earth, her shadow would pass over one hundred and seventy miles; but I wish to know, how this could take place, if an eclipse were to happen, when the earth is so far from the moon, that the lines 8—10, 9—11, *would cross each other, before they come to the earth?*

A person, situated on the earth, in a direct line between the centres of the sun and moon, would see a ring of light round the dark body of the moon, called an annular eclipse: when this happens, there is not a total eclipse any where, because the moon's umbra does not reach the earth.

How long does such an eclipse usually last?

An annular eclipse does not continue longer than twelve minutes, nor a total more than seven minutes. The duration of an eclipse of the sun can never exceed two hours.

Will you explain to me the cause of an eclipse of the moon?

This arises from her entering the earth's shadow, and consequently it must happen, when she is in opposition to the sun, that is, at the time of full moon, when the earth is between the sun and moon.

Will the same figure explain this also?

It will, if I add another representation of the moon, so as to allow the earth, to intervene between the sun, and moon.

Let S, again represent the sun, E, the earth, and M, the moon, in the earth's umbra, 7 8 and 9 the penumbra. Now, the nearer any part of the penumbra is to the umbra, the less light it receives from the sun, as is evident from the figure; and, as the moon enters the penumbra, before she enters the umbra, she gradually loses her light, and appears less brilliant.

How long does an eclipse of the moon last?

From the time of her first touching the earth's penumbra to her leaving it, five hours and a half, may elapse, but not more.

But how long does the moon continue in the earth's umbra?

Not more than three hours and three quarters.

How long may she be totally eclipsed?

About an hour and three quarters.

May persons on all parts of the earth see the eclipse?

All those, who can see the moon.

Why?

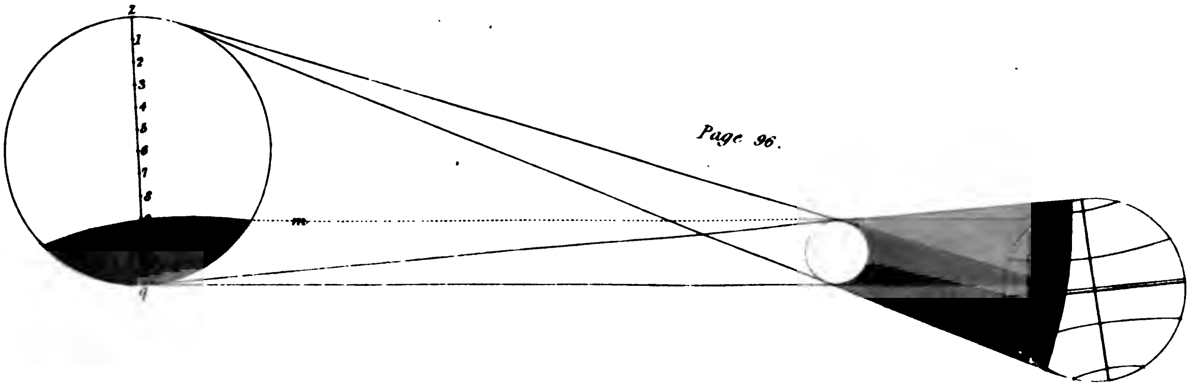
Because the moon is entirely deprived of light during an eclipse.

Why is an eclipse of the sun but seven minutes, and that of the moon an hour and three quarters?

This arises from the different sizes of the bodies that cause the eclipse, the shadow being proportioned to the size of the body. This drawing will give a striking proof how very large the sun is in comparison of the earth.

The dark shadow *n o* is the track made by the central shadow over the earth, so that after the shadow has passed from *n* to *q*, a spectator at *n* would see the moon leaving the sun along the spotted line *n m*, while the spectator at *q* would observe a total eclipse. If he was nearer the centre of the penumbra, he would have more of the sun's face cut off by the moon. So that the diameter of the sun in every direction is supposed to be divided into twelve digits, as may be seen by the line *z q;* three digits are eclipsed to the spectator *n,* on the sun's disk; and, if the eclipse ended at *q,* would be said to end ninety degrees from a line passing perpendicularly through the sun's centre. Solar eclipses begin and end, well defined as to time, but the earth's shadow is so faint, that it is difficult, even with a good telescope, to ascertain the time when an eclipse of the moon begins or ends.

How many eclipses may there be in a year?



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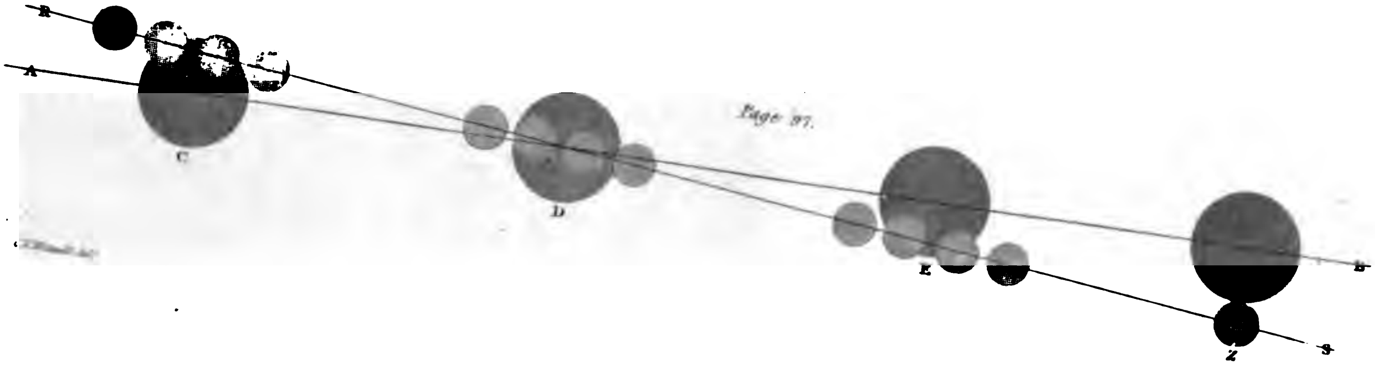

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The average number of eclipses in a year is four, two of the sun and two of the moon; and as the sun and moon are as long below the horizon of any particular place, as they are above it, the average number of visible eclipses in a year is two, one of the sun and one of the moon. The lunar eclipse, frequently happens a fortnight after the solar one, or the solar one a fortnight after the lunar one. I will now with a figure explain to you a question you proposed to me some time since; do you recollect what it was?

O yes; whether the moon, at the nodes, is sure to produce an eclipse.

To this I reply, certainly, when the change, or full of the moon, happens at the nodes, but not then alone; for, when the moon is full at a little distance from the node, she may also suffer a total eclipse; because the earth's shadow is so much more in diameter than she is. Let *A B* be the plane of the ecliptic, in some part of which the earth's shadow will always be. Let a section of that shadow be *C D* and *E;* and let *R S* be a part of the moon's orbit. If the moon is full at *C,* she will pass through the upper part of the shadow, and be but partially eclipsed. But, when she is full, in the node, as at *D,* that node must be in the middle of the shadow, since she will pass directly through it, and be totally eclipsed. So when the shadow is beyond the node, as at E, and the moon is at full; there, she will pass through the lower part of the shadow, and be only partially eclipsed. But, when she is at full at *Z*, she will steer clear of the shadow, and not be eclipsed at all.

This shows, that the limits of eclipses can be only near the nodes; but how great may this distance be?

It is found, that a solar eclipse cannot happen at a greater distance from the node, than eighteen degrees, nor a lunar, at a greater distance than twelve degrees.

Does an eclipse of the moon always begin on the same side?

Yes; on her eastern side, and goes off on her western.

And is it the same with the sun?

No: that of the sun begins on the west, and ends on the east side, to an European observer.

Does the orbit of the moon always intersect the ecliptic in the same points?

No: these points are continually varying. Look at the first drawing I gave you; the node *a* will in a year be moved to *e*, and the opposite node to *t*. In another year the ascending node will have gone back to *Z*, while the descending node will cut 7.

What, then! do these nodes perform a revolution all round the zodiac?

Yes; but it is a retrograde motion, or contrary to the order of the signs.

And how long is she going round?

Almost nineteen years.

What, then! is this the famous lunar cycle, of which you spoke to me before?

It is.

I cannot describe to you, mamma, what I feel. There seem to be revolutions, and counter-revolutions among the planets, without end; and yet these enormous globes proceed, though held up by nothing: each seeks its course with perfect accuracy through boundless space.

And yet I have avoided as much as possible saying any thing, that might have a tendency to perplex the subject, or I should have shown you much more of the moon's varied, and complex velocities, in different parts of the year, and in different parts of her orbit. But let the little, that is now present to your mind, lead you along the track, which is with equal clearness marked for you, to the very footstool of the invisible God. And shall I add, let it lead you with equal velocity too! O my child, let your love of truth, and your devotion to God, be so ardent, that nothing but its being habitual, instead of occasional, could prevent its receiving the name of passion. And when I would stimulate you to action, by the activity of the heavenly bodies, you know my mind takes a reach, which the senses do not authorize. When we were viewing the moon a few evenings back, it was some hours in advancing half a yard from a star which it touched: a motion apparently very deliberate. But what was it in fact? The moon really was driving through the heavens at the rate of considerably more than two thousand miles in an hour. And when to this, we add the consideration that this prodigious rapidity is as much under government, as if the planet proceeded ever so slowly, it should, on the one hand, teach us circumspection, and, on the other, lead us to tremble before the infinite power of Him, with whom we have to do.

Did the ancients pay much attention to the eclipses of the sun, and moon?

There was no subject, to which they rendered a greater measure of attention, concerning which they have invented more absurd stories, or to which their religious worship bore a more immediate reference.

O mamma, I should like to hear some of their strange stories.

Well, then, you shall hear, that on every eclipse, the Hindoos and Chinese believed those planets to be seized upon by a large dragon!

" The Jesuit, Le Compte, giving a description of a partial eclipse of the sun, which he observed in April 1688, informs us, that during the whole eclipse, the Chinese were under the greatest alarm, imagining they were going to be suddenly enveloped in thick darkness, and made every where the most hideous yelling and horrid noises, to oblige the dragon to depart. For to this animal," he adds, "they attribute all the disappearances of the stars which take place, because the celestial dragon being hunger-bitten, at that time holds the sun or moon fast between his teeth, with the intent to devour them."

You have often mentioned to me how deeply the astronomical, and theological, speculations of the ancients were blended together; and surely, this is an illustration.

If so, the religious worship of the Persians, no less declares the same; they chose to perform their adorations to Mithra, in deep caverns, and gloomy recesses. The deeper these caverns, the more gloomy these recesses, the greater was the height of devotion to which their adoration mounted; and their reason for selecting such retreats, was, because they considered it preferable to celebrate the mysteries of religion in the silence of the night, and in the bosom of darkness. Lactantius, who asserts that the Persians were the first people who worshipped the sun in dens, and in caves, adds, that they did so to denote the eclipses of that luminary. Should revolving years allow you to pursue this subject, you will find, that calculations, which attribute to the world such an immense antiquity, as would subvert the Mosaic records, are founded on, and relate to, the retrograde motion of the nodes from east to west, and to the slow decrease of the obliquity of the ecliptic.

CHAPTER IX.

OF THE PLANETS AND THEIR SATELLITES.

Will you, my dear mamma, oblige me to-day, with a general description of the planets? I have collected a number of questions, which I am anxious to propose to you.

That is right: you are sure to make progress, if you let what I impart, stimulate you to thought, when you are alone. The subject you have selected is appropriate; and I will begin by informing you, that the planets, like our earth, are all opaque spherical bodies, which have no proper light of their own, but shine by means of the borrowed light, which they receive from the sun.

How is it known that their light is borrowed?

By telescopical observations, it is found, that only that side of them which is turned towards the sun, is ever illuminated; while the opposite side, which its rays cannot reach, remains continually dark.

Have the planets a motion round their axes, which corresponds with the diurnal motion of the earth?

From the regular appearance and disappearance of several dark spots, visible on their bodies, it is obvious they have such a motion.

Have they a progressive motion round the sun, which answers to the annual revolution of the earth in its orbit?

Their progressive motion round the sun, is proved from their seeming sometimes to be stationary, and from their going backwards at other times.

Which of the planets is the nearest the sun?

Mercury.

How long is he going round the sun, or what is the length of his year?

Eighty-seven days twenty-three hours.

How long is he turning on his axis, or what is the length of his day?

This is not yet ascertained.

What is Mercury's distance from the sun?

Thirty-seven millions of miles.

When is Mercury visible?

A little after sunset, and a little before sunrise.

Which planet is second in order?

Venus.

How long is she going round the sun?

Two hundred and twenty-four days, and seventeen hours.

How long is she turning on her axis?

Twenty-three hours, and twenty minutes.

What is the distance of Venus from the sun?

Sixty-eight millions of miles.

With what degree of velocity does she move?

At the rate of seventy-six thousand miles an hour.

When is Venus visible?

When she rises in the morning before the sun, and is west of him; and then she is called the morning star. When she appears east of him, and shines in the evening after he sets, she is named the evening star. She is alternately in each situation, about two hundred and ninety days.

Which is the planet next above Venus?

The earth.

How long is it going round the sun?

Three hundred and sixty-five days, five hours, and forty-nine minutes.

How long is it turning on its axis?

Twenty-four hours.

What is its distance from the sun?

Ninety-five millions of miles.

With what degree of velocity does it move?

At the rate of fifty-eight thousand miles an hour; which is but little more than half the velocity with which Mercury travels.

Which is the next planet above the earth?

Mars.

How long is he going round the sun?

Rather less than two of our years.

How long is he turning on his axis?

Twenty-four hours, and thirty-nine minutes.

What is Mars's distance from the sun?

One hundred and forty-four millions of miles.

With what degree of velocity does Mars move?

At the rate of fifty-five thousand miles an hour.

When is he visible?

He rises when the sun sets, and sets when the sun rises.

What is the next planet above Mars?

Jupiter.

How long is Jupiter in making the circuit of the sun?

Rather less than twelve of our years.

How long is he turning on his axis?

Nine hours and fifty-six minutes.

What is Jupiter's distance from the sun?

Four hundred and ninety millions of miles.

With what degree of velocity does he move?

At the rate of twenty-nine thousand miles an hour.

At what time does Jupiter appear the largest, and most luminous?

When in opposition to the sun; because then he is much nearer to the earth.

What is the length of his days and nights?

They are each about five hours.

What is the next planet above Jupiter?

Saturn.

What is the distance of Saturn from the sun?

Nine hundred millions of miles. And here I cannot but remark, how admirably situated are these immense planets Jupiter, and Saturn.

Why? what would have been the effect of a different situation?

If they had been situated in much lower spheres, they would certainly have disturbed the motions of the other planets.

And have they no effect now?

At their immense distances, they act almost equally on the sun, and on the inferior planets.

And does that prevent their influence from being detrimental?

Their acting equally, reduces it, in some respects, to be very nearly the same thing as if they did not act at all; while, their happily selected situation may, in other respects, serve to bind and consolidate the whole of the solar system.

The admirable selection of the situations of these planets is the clearer to my apprehension from what you before told me of the inequalities in the moon's motion, occasioned, if I rightly recollect your statement, by her near approach to the earth, and sun, combined with *her diminutive size. May I now inquire, with what degree of velocity Saturn moves?*

At the rate of twenty-two thousand miles an hour.

How long is it going round the sun, or what is the length of its year?

Twenty-nine and a half of our years.

What does its diameter measure?

Seventy-nine thousand miles.

In what time does it turn on its axis?

In twelve hours thirteen minutes.

What is Saturn's appearance?

He shines with a pale feeble light, being considerably less bright than Jupiter, though less ruddy than Mars.

Of what size does the sun appear to the inhabitants of Saturn?

Ninety times less than it does to us; but as a compensation for the scanty supply of solar light, Jupiter and Saturn, are signalized; the former by being surrounded by several parallel faint substances called Belts, the latter by two magnificent luminous rings, which encompass him at such a distance, that a star may sometimes be seen between the inward surface of the ring, and the body of the planet.

What is the breadth of the inner ring?

Twenty thousand miles.

What is the breadth of the outer ring?

Seven thousand two hundred miles.

And what is the measurement of the vacant space between the two rings?

Two thousand eight hundred and thirty-nine miles.

Is the nature of the ring known?

Sir William Herschel thinks it no less solid than the planet, and it appears to be of considerable use in reflecting the light of the sun on that planet.

Is not Saturn the most remote planet?

It was thought so till the 13th of March 1781, when Sir William Herschel discovered another at about double the distance.

By what name is it distinguished?

Astronomers generally call it the Herschel; but Sir William named it the Georgium Sidus, in honour of his present Majesty.

What is its diameter?

Nearly, thirty-five thousand miles. When compared to the earth, it is as four hundred and thirty-one thousand, seven hundred and sixty-nine, to one.

What is its distance from the sun?

One thousand eight hundred millions of miles.

How long is it journeying round the sun?

Eighty-two of our years.

How many miles then does it travel in an hour?

Sixteen thousand.

But, mamma, if this planet has been discovered only thirty-seven years, how is it known that it will complete its revolution in eighty-two years?

By a long series of observation it has been found to move with such a velocity as will carry it round the heavens in that period. When it was first discovered it was in Gemini, and in August 1803, it had advanced to the 11° of Libra, more than one-fourth of its iourney; and in June 1809, it was in the 8½° of Scorpio.

What is its bulk?

It is eight millions, forty-nine thousand, two hundred and fifty-six times, as large as the earth.

Is its brilliancy considerable?

Yes; between that of the Moon and Venus.

How then did it happen that it was so long undiscovered?

It had, there is reason to believe, been before seen, but it had been regarded as a fixed star. The fact is, we need most powerful incentives to industry, and we cannot be too thankful for the education, which tends to shake off our native indolence, or for any circumstances, that will awaken us to action. The unmanageable length of the telescopes, employed by Huygens, and Cassini, with the constant exposure to the midnight air, necessary to success, had led to the use of shorter telescopes, and perhaps, to a less measure of exertion; so that it was an accident that occasioned the discovery of this planet.

Sir William Herschel, being engaged in the examination of the small stars near the feet of Gemini, observed one considerably larger than the rest; in addition to which, the steadiness of its light attracted his attention. This induced him to apply higher magnifying powers to his telescope, which increased its diameter.—In two days he observed that its place was changed, and he then concluded it was a comet; but, in a little time, himself, Dr. Maskelyne, and others, determined that it was a planet.

Are these all the planets which belong to the solar system?

No: astronomers, aroused to action by the success of Dr. Herschel, have delighted the inquiring world by continued additional discoveries.—Professor Piazzi, of the university of Palermo in Sicily, discovered a planet on the 1st of January 1801.

Where is it situated?

Between Mars, and Jupiter.

What is it named?

In compliment to his sovereign, the founder of the observatory at Palermo, Piazzi denominated it Ceres Ferdinandia: it is now generally called Ceres.

What is the aspect of this planet?

Being of a reddish hue, it is thought to resemble Mars.

What is its size?

Its diameter is about a fourth part of the diameter of the Georgium Sidus.

Have you yet another discovery to tell me about?

Yes: on the 28th of March 1802, Dr. Olbers, of Bremen in Germany, observed a new planetary body, of small apparent magnitude.

Does its light resemble that of Ceres?

No: its light is pale, and white.

What is its name, and where is it situated?

Pallas is its name, and it is situated between the orbits of Mars and Jupiter.

Have these planets any moons accompanying them?

Not any have been observed; and, indeed, though frequently spoken of as planets, Sir William Herschel considers them as the occupants of a middle rank, between planets and comets, and therefore has named them Asteroids. A similar kind of planet was discovered by Mr. Harding, of Bremen, on the 1st of September 1804: it has been named Juno. It appears like a star of the eighth magnitude, and is at about the same distance from the sun as the other two. A fourth, and the last which I have to name, was discovered on the evening of the 29th of March 1807, by Dr. Olbers, already mentioned.

What name has he given to this planet?

Vesta.

What is the length of its year?

The annual revolution of each of these planets, is performed in about five of our years. A more exact statement you will find in an accompanying memorandum*.

So much was I pleased with what you told me about our moon, that I long to hear something respecting the satellites of the other planets. Do they not revolve around their primaries, in the same way as our moon revolves about us?

Exactly so; and probably, answer all the purposes for them, that our moon does for us.

How long is our moon going round the earth?

A month.—At what distance from the earth does she journey?

I do not know.

At the distance of two hundred and forty thousand miles.

Jupiter has, I am told, a considerable number of satellites.

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* Memorandum VI.

Jupiter has four, which revolve about him at different distances, and in different periods. The first, in one day, eighteen hours; the second, in three days, thirteen hours; the third, in seven days, three hours; and the fourth, in sixteen days, sixteen hours.

I have often been much pleased by looking at prints of Jupiter and his moons.

Never do so again, without remembering the compensations, provided for the accommodation of its inhabitants. That all the planets could be placed equally near to the source of light, and heat, and attraction, was impossible; but, if I may speak figuratively, we shall find, that all the apartments in this splendid mansion are fitted up with admirable contrivances, and unerring wisdom.

As far as we know, where the light of the sun is enjoyed in a more abundant degree than it is with us, there, no reflected light is added; and, where less is communicated, there, reflectors multiply. In the present case, we see four moons; as the necessity augments, we find seven; and I doubt not, as the case became still more urgent, we shall find ten.

But does this attention, to remove, or lessen inconveniences, evince itself in other instances?

It displays itself through the whole of creation. A few additional illustrations I will give to you on a paper*, which I will put into your hands.

In what periods of time do the satellites of Saturn revolve round him?

The one nearest to him performs its revolutions in twenty-two hours and a half; and that which is most remote, in seventy-nine days, and seven hours.

That these moons are subject to the same laws which govern our own, appears a rational conclusion; but it is, I suppose, impossible to obtain any further satisfaction than that which arises from reasoning by analogy.

We are not altogether restrained to that: for this last satellite is seen to turn on its axis, at the same time that it passes round the planet.

You doubt not, you say, we shall find ten attendants upon the Georgium Sidus; but how many are already discovered?

Sir William Herschel's discovery of six, has given that astronomer very considerable pleasure.

In what period do they perform their revolutions?

The one, nearest to the planet, performs its revolution in five days, and twenty-three hours; but that, which is most remote, takes for this purpose, one hundred and seven days, sixteen hours.

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* Memorandum VII.

You have, my dear mamma, in a former conversation spoken to me of the Chaldeans: did they distinguish between the fixed stars, and the planets?

I will furnish you with an illustration that they did: and as I have already slightly intimated to you their zeal in advancing their benefactors to the starry regions, I will now show you, that, if we may believe them, the beautiful and resplendent planets shine not without being tenanted by individuals equally interesting.

O, how much obliged to you I shall be for that!

In the Pagan world, the sun was considered as the sovereign deity, the source of light, and the principle of nutrition; and their gratitude induced them to adore that star as a god. Feeling a kindred respect, on similar accounts, for their parent Noah, they consigned his spirit to that orb. But it was impossible to separate the idea of Noah, from the ark in which he was preserved.—They imagined that the ark resembled the lunar crescent; the moon in that state was the memorial of that voyage; and their first family and immediate descendants are, in consequence, still denominated all over the East, the Children of the Sun and Moon. I will now direct your attention to the planet Saturn.—Here, as in all the heathen mythology, we find a mysterious compound, consisting of the physical history of the planet, according to the superstitious notions of the oriental philosophers, and the history of the deified mortal, who, for his wise and virtuous reign, was exalted to that bright, but distant abode.

Will you favour me with the notions of the oriental philosophers?

These you may gather from the mode of representation, by which he is portrayed in the eastern mythologic history of this planetary god.

How is that?

He is painted of a blue colour, with a dreadful and malignant aspect, devouring his children. He has four arms, is mounted on a raven, and surrounded by two serpents, whose intertwining bodies form a circle round him.

What am I to understand by all this?

As Saturn himself is a personification of time, which moves on slowly, yet most certainly advances (as does the planet himself); we must, by his children, understand the revolving years.—As their bodies were intertwined, so are the revolving years closely connected with each other.

But who is the wise and virtuous king exalted to this distant abode?

The Janus of the western world, the venerable Noah.—Hence may be seen medals of this deified mortal, bearing two heads joined by the hinder parts, with the prow of a ship often on the reverse. Macrobius informs us, his two faces denoted that he knew both past and future things, and the fingers of his statues were so joined, as to express the number three hundred and sixty-five.

What was that to intimate?

The days of the year; a circumstance which may be regarded as a token of the great proficiency of Noah, in astronomy.

Who had the honour of being advanced to an abode in the sphere of Jupiter?

Ham, the third son of Noah, the true Jupiter Hammon of antiquity, the founder of the Egyptian nation, whose country, in the Bible, is called the Land of Ham.

Noah, you have told me, was exalted to the Sun, and to Saturn. Was Ham thus doubly honoured?

Yes; he was not only immortalized in this planet, but in the constellation Aries.

Who has found a supposed residence in the planet Mars?

The indefatigable Mr. Maurice thus answers such an inquiry :—"From the derivation of his name, from the sanguinary, and terrific aspect, of the planet, and the inauspiciousness of the day distinguished by his name, I should be inclined to think, that the warlike and tyrannical Nimrod, was the tyrant spirit, that was supposed to reside and rule in Mars."

And who in Venus?

Semiramis, the Dea Syria of Babylon.—She shone forth upon the abject race who deified her, with equal lustre in the Pleiades, and in the morning star.

Whom am I to recognise in Mercury?

Budda, who was possibly no other than the Phut or Phruth of Scripture, the third son of Ham.

I thank you, mamma; but may I tell you what I was, this morning, reading before you came down to breakfast?

Certainly.

It was an account of the palace of Deïoces, king of Media.

Well, what of that?

I read, that this palace was situated in the most interesting part of Ecbatana, that it was surrounded by seven circular walls which Deïoces placed on a hill rising in ascent one above the other, and were painted of seven colours, not unaptly representing the planets: while the inner wall, which enclosed the royal palace, stood preeminent in beauty, the outer and lowest wall was of amazing extent.

Intending to request that you would allow the planets to be the subject of our conversation today, I have treasured this up, that I might ask you of what colours the walls were painted.

Whilst the first was painted white, the second black, the third purple, the fourth sky-blue, and the fifth a deep orange, the sixth was covered with plates of silver, and the seventh with burnished gold.

What could the gold and silver be intended to represent?

Doubtless the sun and moon; and this is rendered more evident by a remark made by Mr. Maurice, that it was in the cave of Mithra, which was originally instituted in the Median mountains, that the orbs of the sun, and moon, were first formed of these metals: and though the colours white, black, purple, blue, and orange, are not those by which modern chemists designate the planets; yet it evinces, that in Media, they had at that early period noticed a variety in the colour of these bodies.

At how early a period was this?

It was seven hundred years before Christ. Deioces was the first king of the Medes, who, having delivered his country from the Assyrian yoke, was raised to be their sovereign for his wisdom and virtue.

But how is it, that we designate the planets in astronomy, and the metals in chemistry, by the same characters?

Astronomy, and chemistry, were sister-sciences in those early days, and the mode of designating the planets and metals by congenial characters, descended to the Arabians, from the old school of Zoroaster.

I recollect how the sun, the most brilliant orb, and gold, the brightest metal, are described.

In what way, and from what cause?

By a circle, which denotes perfection.

The moon, the next planet, which is evidently illustrative of purity, was shadowed out by silver. But how are they represented?

By a mark in the form a crescent.

The other astronomical, and chemical characters, are composed out of these two, with only the addition of the Egyptian cross, which was their symbolical representation of matter; and, as the ancients almost invariably joined to the circle, the cross, they intended to describe, the invigorating power of the sun acting upon dead matter. But the union of the circle and cross, in their planetary designations, seems intended to point out the solar or lunar influence, of which the planets partook, and which, they having received, diffused, together with their own influence, upon the various elements of fire, earth, air, and water. We shall be the rather confirmed in this, when we reflect on their proneness to astrology, and the powerful influence they consequently attributed to the planets. Do you recollect how you have seen Mercury portrayed in mythological publications?

He is decorated with wings, both on his hands and feet, and with a caduceus, which you have told me, represents the oblique path of the sun.

Since he is decorated with wings, on his hands and feet, to indicate the swift motion of the planet round the sun, you can soon tell me what metal the ancients would select, as most descriptive of the same property.

It was, I dare say, quicksilver.

Yes; and in the character of this orb both the solar, and lunar, designations are united, together with the mystic symbol of the elements. "It is," observes the writer of Indian Antiquities, "very remarkable, that this artificial combination of characters evidently presents to our view the famous caduceus, by which that deity was universally denoted in the ancient world." Can you point out to me the same apt selection of a metal to designate the planet Saturn, as you have discovered to represent Mercury?

Lead has, I believe, been chosen, on account of its heavy nature, to express the slow motion of Saturn.

There is also in lead a blueish cast, which is in a marked manner, the colour of that very distant orb.

The colour of Mars caused it not unaptly to be associated with copper.

How is Jupiter designated?

By the lunar character, with the same cross placed horizontally upon the inferior part of the semicircle; and Venus is denoted by the astronomical character of the sun, whose rising, and setting, she attends, as the morning, and as the evening, star; with the elementary symbol depending from the circle. Such was the original designation, and such, perhaps, was the true meaning of the planetary characters; though, from time and caprice, the above representations have nearly all suffered some alteration, as may be seen by casting your eye on the following list.

Mercury	☿	☿	Jupiter	♃	♃
Venus	♀	♀	Saturn	♄	♄
Mars	♂	♂			

CHAPTER X.

ON COMETS.

Are not comets important bodies belonging to our system? Will you kindly inform me, how I may distinguish them?

Comets are solid opaque bodies, of different magnitudes, like the planets, but are distinguished by fiery tails, or long beards of transparent hair.

From which side does the tail issue?

From that side of them which is furthest from the sun.

Has the tail the same degree of lustre throughout?

No: the lustre is the most considerable near the body of the comet, and becomes less, and less, the further it is removed thence.

Is there not a popular division of comets into three kinds?

Yes; there is such a division, but it rather relates to the several circumstances of the same comet, than to the phænomena of several: the divisions are, the bearded, the tailed, and the hairy comet.

Will you explain this remark by an illustration?

When a comet is eastward of the sun, and moves from it, it is said to be bearded, because the light precedes it, in the manner of a beard.

What is it termed, when the comet is westward of the sun, and sets after it?

It is said to be tailed, because the transparent hairlike appendage, follows it in the manner of a tail.

When the comet, and the sun, are diametrically opposite, the earth being between them, what is the term employed?

Then the train is hid behind the body of the comet, except a little which appears round it, in the form of a border or tuft of hair, or coma; hence it is called hairy, and from hence the name, comet, is derived.

Is the body as well as the tail of the comet subject to apparent changes?

Yes; and these Sir Isaac Newton ascribes to changes in the atmosphere of the comet. His opinion was confirmed by observations on the comet of 1774.

At what periods have very interesting comets made their appearance?

In Dr. Rees' Cyclopedia you will find the elements of ninety-seven comets, and the names of the authors who have calculated their orbits.

But a few words respecting the comets of 1680, 1661, and 1664, will answer my purpose.

As the elements of so large a body of comets are given, they have, I suppose, in common with other heavenly bodies, claimed the attention of astronomers in every age?

Not so; and nothing is more to be regretted by posterity, than that the ancients considered them as portentous signals of approaching calamity, instead of regarding them in a philosophical point of view.

What, then, were they altogether neglected by ancient astronomers?

They were, at most, considered only as meteors, or sublunary vapours floating in the atmosphere.

Whose attention did they first excite, and by whom were they first regarded as bodies of more importance?

Seneca, who was born six years before Christ, paid considerable attention to them, in consequence of the appearance of two, in his own time. But his observations remain unrecorded.

Who then was the first, who described with any degree of accuracy the path of a comet?

Nicephorus Gregorius, an astronomer and historian of Constantinople. Deeply impressed with the neglect of his predecessors, he composed that stupendous effort of human industry, "The Table of the Elements of Comets."

O mamma, with what multiplied specimens of energy, and with what vast achievements of industry, do you furnish me! Surely I ought to catch one spark of ambition from the fire burning on that altar. With a reputation ever gathering, shall the name of such a man descend to posterity. But may I ask, what was the appearance of the comet of 1680?

Sturmius tells us, that when he viewed it with a telescope, it appeared like a coal dimly glowing, or a rude mass of matter, illuminated with a dusky fumed light, less sensible at the extremes than in the centre.

What was the appearance of the comet of 1661?

Hevelius observed, that its body was of a yellowish colour, very bright and conspicuous, but without glittering light. In the middle was a dense ruddy nucleus, almost equal to Jupiter, encompassed with a much fainter, thinner matter.

But do these instances evince, that the body of the comet is subject to apparent changes?

No, they do not; therefore I will enter a little more into the detail. On the 5th of February, the head of the last-mentioned comet was somewhat bigger, and brighter, than it had before been; it was of a gold colour, but its light was more dusky than the rest of the stars, whilst the nucleus appeared divided into several parts. February the 6th, the disk was lessened, the nuclei still existed, though less than before: February the 8th, its body was round, and represented a very lucid little star, the nuclei were still encompassed with another kind of matter. February the 10th, the head was somewhat more obscure, and the nuclei more confused, but brighter at the top than at the bottom. February the 13th, the head was much diminished, both in magnitude and brightness. March the 2d, its roundness was a little impaired, its edges lacerated, &c. March the 28th, it was very pale and exceedingly thin; its matter was much dispersed, and no distinct nucleus appeared.

What is the description given of the comet of 1664?

Weigelius says, that he saw the comet, the moon, and a little cloud illumined by the sun at the same time; and he observed that the moon, through a telescope, appeared of a continued luminous surface, but the comet very different, being exactly like a little cloud in the horizon illumined by the sun.

I have heard various conjectures respecting the cause of the tails of the comets: will you have the goodness to mention to me the most plausible opinion?

It is that formed by Hevelius, who supposes that the thinnest parts of the atmosphere of a comet are rarefied by the force of the heat, and driven from the forepart and from each side of the comet, towards the parts turned from the sun.

What is the greatest distance from the sun, at which a comet can be situated, to be visible to us on the earth?

About three times the distance of the sun from the earth.

At what distance from the sun, was the comet of 1680, *at the period of its greatest heat?*

About four sevenths of the earth's distance from the sun, or forty-six millions, two hundred and eighty-five thousand miles, nearly.

When a comet has been once seen, can the period of its return be foretold?

Not with any degree of certainty, though it is possible, that the periods of three of them may have been ascertained. The first of these appeared in the years 1531, 1607, and 1682, and is expected to return every 75th year: there is also another, which by its return in 1758 gratified astronomers, as its appearance corresponded with the prediction of Dr. Halley.

When did the second appear?

In the years 1522, and 1662; and it was expected that it would again make its appearance in 1789, but in this the astronomers of the present day have been disappointed.

Which is the third comet that you referred to?

It is that, which appeared in the year 1680; and its period being estimated at 575 years, it cannot, upon that supposition, return until the year 2255. This last comet, at its greatest distance, is eleven thousand two hundred millions of miles from the sun, and its least distance from the sun's centre, was about four hundred and ninety thousand miles: in this part of its orbit, it travelled at the rate of eight hundred and eighty thousand miles an hour.

Some wonderful change or changes in nature must, I suppose, be connected with the appearance of comets, from the terror which they still excite, in the minds of many.

The universal deluge is attributed to the comet of 1680. Whiston supposes that the earth passed through the atmosphere of that comet, and attracted from it a considerable part of the waters of the flood: that the proximity of the comet raised a great tide in the subterraneous waters, so that the outward crust of the earth, was changed from spherical to oval; that this could not be done without making fissures and cracks in it; that through these fissures, the subterranean waters were forced, in consequence of the change of the hollow of the earth into a less capacious form: that along with the water thus squeezed up, much slime or mud, would rise to the surface of the earth, which, together with the grosser parts of the comet's atmosphere, would, after the subsiding of the water (partly into the fissures, and partly into the lower parts of the earth to form sea), cover to a considerable depth, the antediluvian world; and thus he accounts for the trees and the bones of animals found at very great depths in the earth. This is not the only change supposed to be connected with the appearance of this comet; but also the general conflagration, foretold in the sacred writings. It is supposed that this comet, by coming near the earth, will be the instrumental cause of that awful event.

From this last observation, am I to conclude, that comets have light and heat of their own, or that they are borrowed from the sun?

This inquiry we will divide into two parts. First, then, do comets shine by their own light? It was, till within these few years supposed, that comets borrowed all their light from the sun; but the appearance of two very brilliant comets of late seems to have overturned that theory. One of these was visible for several weeks in 1807; and the other, from September, to the end of the year 1811. Of the former Sir William Herschel has given an elaborate account, in the ninety-eighth volume of the Philosophical Transactions. Previously to their appearance, it was generally supposed, that the light of comets, like that of the moon and planets, was only a reflected light.

A new theory is now adopted by Sir William and other eminent astronomers, who have had capital opportunities, in both the instances referred to, for accurate observations.

Herschel says with respect to the comet in 1807, " We are authorized to conclude, that the body of the comet on its surface, is self-luminous, from whatever source this quality may be derived. The vivacity of the light of the comet, had a much greater resemblance to the radiance of the stars, than to the mild reflection of the sun's beams from the moon." The same inference has been drawn from the observations made on the comet of the year 1814, which distinctly exhibited to very powerful telescopes, the several parts of which the comet is composed.

What are these parts?

They are the nucleus, the head, the coma, and the tail.

What do you mean by the nucleus?

It is a very small, brilliant, diamond-like substance in the centre, so small as to be incapable of being measured.

What is included in the term head?

All the very bright surrounding light: inferior telescopes that will not render the nucleus visible, are often able to exhibit the head thus described.

The head of the comet of 1807, was ascertained to be five hundred and thirty-eight miles in diameter; that of 1811, to be about the size of the moon.

The term coma you have already explained, and the term tail is obvious. But what may have been the length of the tail of a comet?

That of 1807, was ascertained to be more than nine millions of miles in length; and that in 1811 was full thirty-three millions. O my dear child! mark the immensity of creation; for they pursued their course undisturbing, and undisturbed, and occupied apparently an insignificant portion of space.

But you were, my dear mamma, to inform me, if comets possess heat, independent of the sun.

If comets are "self-luminous," it is probable they do; one beneficial effect, which Sir Isaac Newton conjectures, comets may afford, is that of recruiting the sun with fresh fuel, and repairing the consumption of light and heat, by the streams continually sent forth in every direction from that luminary.

But let them be supposed not to possess heat independent of the sun, and then what degree of *heat might they acquire by their near approach to the sun?*

The comet, seen by Sir Isaac Newton, in the year 1680, was observed to approach so near the sun, that its heat was estimated by that great man to be 2000 times greater than that of red-hot iron.

Will you give me any idea, how long a body thus heated, would retain its heat?

A red-hot globe of iron of a single inch in diameter, exposed to the open air, will scarcely lose its heat in an hour; and it is said that a globe of red-hot iron, as large as our earth, would scarcely cool in fifty thousand years*.

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* See Enfield's Institutes of Natural Philosophy, p. 296, 2d edition.

CHAPTER XI.

CONCLUSION.

Before I withdraw your attention from the solar system, I wish to press upon you five or six important inquiries.

We see stationed in this system, a stupendous globe of luminous matter, and observe revolving around it, opaque planets with their accompanying dark satellites; but the observations we have just made on comets show us, that there is nothing which renders such an arrangement in nature unavoidable, nothing that requires that the body which is stationary should be on fire, while the revolving bodies should be dark, and cold. How shall we account for this disposition of the planets? why not all light, all dark? why not a small dark body at the centre? and, if light must exist somewhere, why should we not find it at the confines of our system?

Mamma, how great would be the inconvenience and the misery of such an arrangement! It would be as bad as our having our eyes placed at our fingers' ends.

But why should the planetary bodies be so admirably adjusted, that the equatorial parts do not become the polar, or the polar the equatorial?

This cannot, I am sure, be the result of some lucky accident; but the cause I am unable to explain.

The fact is, that, out of the infinite number of axes of rotation, upon which the planets might by a random stroke have accidentally fallen, the best of all has been selected; for, while the number is infinite that might have been wrong, those axes only, which pass through the longest, or the shortest diameters, can be permanent. Now, it is delightfully satisfactory to observe, that, while choice was restricted to such narrow limits, it has in all instances exhibited its perfection, by its selection of the shortest, and consequently of the most permanent axis of rotation.

Pray tell me something more: this is the very information I am so anxious to possess.

Well, then, there is a certain very simple law impressed upon bodies, which is truly wonderful in its effects. The law is, that all bodies shall continue in the state in which they are, whether of rest or of motion. If in motion, they shall go on with the same velocity, and in the same line, on which they were proceeding, till something shall change their course.

Mamma, is this the law, and are you now going to tell me its effects?

I am: it is most curious; for it is by virtue of this law that attraction never has brought, nor never can bring, the planets to unite at a centre, but will keep them for ever circulating.

How beautiful!

But what is particularly worthy of observation, is the admirable nicety with which these two forces balance each other. Why was not the centripetal force greater; why was it not less; why did it exist at all? Why was not the power of attraction greater? why was it not less? or why did this exist at all?

I suppose, mamma, had the attractive force varied greatly, the human species could not have existed. If it had had but little influence, worlds would have been running on to their own destruction; if it had had a greatly superior power, it would have buried us in its bosom.

Very right: but, you must observe, that, as the power of attraction exists in all bodies, of course it exists in each of the planets, and in each of their satellites, as well as in the sun: hence, each separate body of which our system is composed, attracts, and is attracted; therefore, the antecedent probability of their disturbing each other, in their revolutions, becomes very great.

And is every thing arranged with so much care, as to prevent even this?

Yes; to prevent every thing but periodical irregularities, nothing that is permanent, or can injure, either the planet, or its inhabitants, can take place.

What were the means necessary to produce a result so astonishing?

It was indispensable, that the force of attraction should diminish, as the square of the distance of bodies increases, that the masses of the revolving bodies should be small, compared with that of the body at the centre; that the orbits should not be much inclined to one another, and that their eccentricities should be but little.

I think I understand the importance of these rules, unless it be the first.

To explain that, suppose, that, instead of the power of attraction diminishing by distance, it had increased: think then of the planet Saturn, so large and so remote, "endued with the power of pulling the harder, from its being the further off." The result must have been, that it would have dragged in the course of years, our globe, or some of its sister planets, out of their courses, and have interfered with the order, and perplexed the motions, of our system.

I quite understand now; will you tell me any thing more?

Yes, one observation more, and then I have done: this relates to the orbits of the planets.

"The distance from the centre, at which a planet sets off, and the absolute force of attraction being fixed, the figure of its orbit depends upon two things: the velocity with which the planet is projected, and the direction which it takes. And these, in order to produce a right result, must be within certain narrow limits. One, and only one velocity, united with one, and only one direction, will produce a perfect circle. And the velocity must be near to this velocity, and the direction also near to this direction, to produce orbits such as the planetary are, nearly circular, that is, ellipses with small eccentricities. The velocity and the direction must both be right. If the velocity is wrong, no correctness of direction will rectify the error; if the direction is in any considerable degree oblique, no velocity will produce the orbit required."—"Why then did the projectile velocity, and the projectile direction of the planets, happen to be nearly those, which retain them in a circular form? Why not one of the infinite number of the velocities, one of the infinite number of directions, which would make it approach much nearer to, or recede much further from, the sun?"

I see, my dear mamma, the unavoidable conclusion; but you say, "nearly in a circular form:" do you mean to intimate, that there is a degree of velocity, or a line of direction, preferable to that imposed upon the earth, and the other planets?

Would it, do you apprehend, be better for them to move in circular, than in elliptical orbits?

No; that is not my conception of the matter: for, if "the system had retained in other respects its present constitution, though the planets had been at first sent round in exact circular orbits, they could not have kept them: and, if the law of attraction had not been what it is, every deviation would have been fatal: the planets once drawn, as drawn they necessarily must have been, out of their course, would have wandered in endless error." To what must we ascribe such obvious proofs and developements of "choice,"—"determination,"—"regulation," care, foresight, and benevolence?

To the existence of a Being too wise to err.

O! may the mysteries of Providence, intricate as the "mystic dance" of the planetary orbs, never weaken in your mind this conviction, much less shake the stability of your faith!

END OF THE FIRST PART.

PART THE SECOND.

PART THE SECOND.

CHAPTER XII.

OF THE STARRY HEAVENS.

My dear mamma, you have directed my attention to the solar system: I have beheld the sun an immense body of fire placed in the centre, I have seen the planets, satellites, and comets, perform their revolutions around him. What shall we talk about to-day?

Shall we, my child, inquire, if there is nothing beyond those limits? The planetary system has its boundary, but space has none. There are but six planets visible to the naked eye. What then is that multitude of other stars, which sparkle in our firmament? The planets all circle around the sun, but the other stars do not own his dominion, they move not around him. To all common observation they remain motionless, each "the independent sovereign of his own territory." What are these distant fires lighted up in the distant parts of the universe?

Propose not the question to me, my dear *mamma, or propose it, only that I may be instructed by you.*

My dear child, each of these luminaries, which we term stars, indicates a system as vast and as splendid, as the one which we inhabit. Worlds, roll in these distant regions, and these worlds must be the mansions of life, and of intelligence! In yon silvered canopy of heaven we see the broad aspect of the universe, where each shining point, presents us with a sun, and each sun, with a system of worlds, where the Divinity reigns in all the grandeur of his high attributes, where he peoples immensity with his wonders, and travels in the greatness of his strength, through the dominions of one vast and unlimited monarchy.

What then may be the number of suns and of systems?

The unassisted eye of man, can take in a thousand, and the best telescope, which his genius has constructed, can take in eighty millions.

May this then be the extent of the universe?

That is impossible! Why subject the dominion of the universe, to the eye of man, or to the powers of his invention?—"Fancy may take its flight far beyond the ken of eye or of telescope, it may expatiate on the outer regions of all that is visible, and shall we say there is nothing there?"

Never did these words of David appear to me half so full of meaning, "Lord, what is man, that thou art mindful of him? or the son of man, that thou regardest him?"

That I dare say is the case, and there are three or four interesting positions connected with our present subject, which, if I can place in a view simple enough, will tend to fix, and rivet, the impression that is now made. My first position will be, that these suns move; then, that these suns, which move, are innumerable; that these innumerable moving luminaries are infinitely distant; and, lastly, that these distant suns form clusters, or systems.

Will you begin with the first observation, mamma; and show me that these suns are in motion?

Yes. The action of two forces is, we know, necessary to enable the satellites to circle around their primaries, and to support the primaries in their revolution round the sun. We know also, that each of these bodies has a compound motion, and that each one, while it turns upon its own axis, revolves round a common centre. We are assured, the sun has one of these motions. He turns on his axis. May he not also, in common with the planets, have a second motion? may he not be describing a tract in space, and in so doing be carrying all the planets, and all their secondaries, along with him?

Mamma, what do you think? does it appear to you probable?

Yes; it does appear to me highly probable, that the plan which we find adopted in our humbler astronomical walk, is pursued in the loftier regions of immensity; and in this opinion we shall rather be confirmed by this consideration, that, in the course of ages, the stars in one quarter of the celestial sphere, are receding from each other, and in the opposite quarter, they are drawing nearer to one another.

Is this by a very slow motion?

By an advance of about fifty seconds in a year; so that it will require 25,791 years, for the equinoctial points to perform an entire revolution, westward round the globe.

This is slow indeed!

Nevertheless it is, in one sense, a perceivable motion; for the stars, which were formerly in Aries, are now in Taurus, and those, which were in Taurus, are in Gemini, and so of the others; and those stars, which rose and set at any particular season of the year, in the time either of Hesiod, or Eudoxus, or Pliny, do not answer to the descriptions of these writers: so that it is probable, that in the same manner, as the planets with their satellites revolve round the sun, the sun with his tributaries, revolve round some common centre, "describing the sweep of such an orbit in space, and completing the mighty revolution in such a period of time, as to reduce our planetary movements, and our planetary seasons, to a very humble rank in the scale of a higher astronomy."

What may this common centre be?

It may be one immense body, whose emanations bind all the revolving bodies, and keep them harmoniously performing their parts. It may be one common system, which regulates the others, by the number and the size of the bodies, of which it is composed. The possibility of this is supported by the fact, that there is room for all this in immensity on the one hand, and it is rendered probable by the records of actual observation on the other, which present us with a gradation in the works of God truly astonishing.

The satellites accompany the planets, the planets follow the sun, and the sun himself is connected with a system of stars, over which presides another sun of superior magnitude, and force, and so on, through a number of variations, and degrees, which the imagination cannot reach. Thus much for the first position.

Shall we now, mamma, proceed to the second, that these suns, which move, are innumerable?

Yes; since the invention of the telescope, the number of the fixed stars is proved to be infinitely greater, than the arithmetic of man can compute. For instance, the galaxy, or milky way, is one continued cluster of small stars, which, in consequence of their number, illuminate that part of the firmament, and diffuse that shining whiteness around it which we observe. No words of mine, will express to you the idea which it is desirable for me to convey, so well as the language of Milton, when, speaking on this subject, he says,

> "A broad and ample road whose dust is gold,
> And pavement stars, as stars to thee appear,
> Seen in the galaxy, that milky way,
> Which nightly, as a circling zone thou seest
> Powder'd with stars."

Do you wish me to apply the observations which you made about the motion of the sun, to this innumerable host of suns?

Yes, I wish you to consider each star, as the centre of a system, and each system, as being completely independent of the rest.

But you know, mamma, that the milky way rather appears like a delicate band of light, than an assemblage of glittering points, or fixed stars.

While this remark establishes the next position I have to advance, namely, the distance of these luminaries, it confirms our present observation, that they are innumerable; or otherwise, from the immense distance at which they are situated, they would not attract the least attention: whereas this is the fact, that the lustres of these distinct suns, embody themselves in each other, and form a beauteous stream of light.

Did you not mention something about the motion of the earth, which conveyed an idea of the immense distance, at which these bodies must be situated?

Express the substance of that which you recollect.

You said, that though the earth is two millions, seven hundred and fifty-four thousand miles, nearer to the sun at one time of the year than another, yet this bears so small a proportion to its mean distance from him, that it makes little, or no variation, in the heat or cold of the different seasons.

This and similar considerations certainly assist in raising our minds, as far as they are capable, to an elevation suitable for the contemplation of the extent of creation. I will, therefore, furnish you with two, or three, additional illustrations. The Georgium Sidus revolves round the sun in an orbit of about ten thousand millions of miles in circumference, and some of the comets make excursions of many millions of miles beyond this, and yet at that immense distance, they are incomparably nearer to the sun, than to any of the fixed stars, as is evident from their keeping clear of those bodies, and returning periodically by virtue of the sun's attraction.

Again, the star, which is the nearest to us, and consequently the largest in appearance, is Sirius, or the Dog-star; and yet such is its remote situation, that, though the earth, in moving round the sun, is one hundred and ninety-five millions of miles, nearer to it in one part of its orbit than in the opposite one, its magnitude does not appear to be in the least altered, or its distance affected by it. The celebrated Huygens carried his thoughts so far on the subject, as to believe there might be stars at such inconceivable distances from our earth, that their light, though it is known to travel at the rate of ten millions of miles in a minute, has not yet reached us since the creation.

Now, mamma, do you think these suns are scattered uniformly through space, each being equally distant from the other?

The probability appears to be, that there is a vast multitude of suns, situated at about equal distances from each other, forming a system of suns, while each independent sun is as completely head of his own domain, as we find ours to be. But though the suns in a cluster or system may preserve a relative distance, it is not obvious to us, that the clusters themselves are subject to this arrangement; for, while the heavens are in some parts adorned with appearances brighter than the rest, there are also many large spaces where no stars are to be seen.

Are these assemblages of suns designated by any particular names?

Yes; they are distinguished by the name of nebulæ.

Are they very numerous?

The number of nebulæ was formerly imagined to be about one hundred and three; but Sir William Herschel, previous to the month of April 1784, had discovered four hundred and sixty-six more; and he is of opinion that the heavens are replete with these nebulæ.

Are there any nebulæ more obvious than the rest?

One of the most obvious to common notice is that large irregular zone, or band of light, which crosses the ecliptic in Cancer, and Capricorn, and is inclined to it in an angle of about sixty degrees.

Is not this the milky way?

It is; and you will take particular interest in surveying it, when I tell you, that Sir William Herschel supposes this to be that particular nebula in which our sun is placed.

I have now briefly touched upon the four topics to which I referred. In proportion as you embody these ideas, will you discern the magnificence of the operations of the Deity. You will mark the sublimity of his procedure, and will behold the march of a God at every advance.

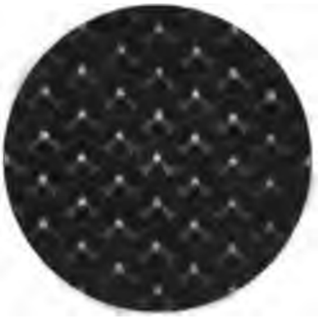
O yes, mamma; but I may say any thing to you: I will, therefore, tell you, that I cannot reconcile what you have unfolded to me, with that minute attention to one insignificant world, which the Bible represents, as having been paid to it.

It is difficult, it is infinitely difficult; but surely the price of our future happiness can never be rightly estimated, but in proportion as we form accurate ideas of God; and, since we cannot see Him, our idea of Him can only be formed from our estimate of his work.

Besides, this is but one among a multitude of difficulties; which arise, not from the impossibility of the thing itself, but from the impossibility of our finite minds taking a reach, lofty as the subject demands. The difficulty you express wears the semblance of modesty, but I cannot but think, it arises from pride. We can scarcely bring ourselves to believe, that the same augmentation in the senses from one to five, which we observe on this spot; may in other regions be carried from five to ten; with greater difficulty still do we believe, that these may be multiplied in numbers, and increased in power, till we arrive at the infinite Mind, which is not perplexed by the variety of intricate combinations, which is not wearied with the minuteness of his own operations.

While you have been speaking, I have thought of one thing, which will be of great use to me.

Part of the Eye of a Fly.



C.V. Whitwell delt [illegible] sculpt

I remember about a year ago, when you first showed me the effects of your solar microscope, I argued just in an opposite direction: for, when I saw the astonishing assemblage of beauties in some insects, as in the diamond beetle, the peach fly, the dragon fly, and the wasp; when I beheld the quills, and painted plumage, on the wings of the butterfly tribe; when I observed the feet, the general organization, but, above all, the eyes of the drone fly, I was overcome: yes, that its eyes, consisting of fourteen thousand hemispheres, and each of these forming a perfect eye, furnished with a cornea, a transparent humour, and a retina, was almost incredible, though I saw it. When you pointed out the telescopic eyes of the snail, and the admirably situated eyes of the spider; when you talked of the animalcules in fluids, especially of the wheel insect; when you showed me that grains of sand are not perfectly globular, but some square, others conical, and most of them irregular; that in each grain there is a cavity, and in each cavity insects of various kinds; and that these little ones are furnished with eyes, mouths, feet—I said, there cannot be many globes like our earth, which are thus the seats of beauty, of elegance, and of conscious existence. But you have proved to me this day, that there are innumerable worlds, and not only innumerable worlds, but systems innumerable.

Yes, my dear child; and seeing that He, who replenished infinite space with myriads of worlds, has also clothed the flowers of the field with a richness, which Solomon could not rival; will you not gather the assured conviction, that he not only regards you, but if you are found humbly serving him, that he also loves you? If you can believe this, then with a devotion you never before felt, you will this evening enter into the holy presence, and worship at the footstool of the self-existent, the independent, the eternal, the unchangeable Jehovah, remembering that it is He, who measured the waters in the hollow of his hand, and who meted out heaven with a span, who comprehended the dust of the earth in a measure, who weighed the mountains in scales, and the hills in a balance—that it is he who did all this, that feeds his flock like a shepherd, who gathers the lambs with his arms, and carries them in his bosom.

CHAPTER XIII.

THE METHOD OF FINDING THE STARS.

The information which you gave me during our last conversation, has greatly increased my anxiety to apply the names, which I find on this globe, to the stars in the heavens.

But did not that information lead you to suppose, that it is a hopeless task?

The facts you communicated did not lessen my conviction of the difficulty, but augmented my determination to overcome all obstacles. I am, I hope, in some measure prepared. The heavens are, I am aware, divided by astronomers into three regions, called the northern hemisphere, the southern hemisphere, and the zodiac.

You know also, that the fixed stars are classed under the outlines of certain imaginary figures, called constellations, and that those, which do not fall within these limits, are called unformed stars.

And I am sure, mamma, you would not have me forget that there are others, which on account of their cloudy appearance are called nebulæ.

Well then, a few evenings, well improved, will enable you to distinguish all the stars of the first magnitude, which are visible, and all the relative positions of the different constellations. Do you know how to find the four cardinal points of the horizon?

I know, that if I look at the sun at twelve o'clock at noon, I am looking to the south, where he then is; being so situated, my back is towards the north, the west is on my right hand, and the east is on my left.

But when the sun is withdrawn, is there nothing you can think of as a substitute?

The north pole star will perhaps answer the purpose of the sun, when he has left us.

You are right. When you are looking to the north, you stand with your face to that star, the south is at your back, on your right hand is the east, and the west is on your left. Now, if you stand facing the south, and observe the heavens, they will appear to undergo a continual change: some stars will be seen ascending from the east, or rising; others descending towards the east, or setting; while in some intermediate point between the east, and west, each star will arrive at its greatest height, or will culminate. The most considerable elevations of the several stars will be different; but these will all be attained, when the stars have arrived at a point exactly half-way between the east, and the west, namely at the south.

If you now turn your back to the south, and observe the north, new phænomena will present themselves. Some stars will appear, as before, rising, attaining their greatest height, and setting; other stars will be seen that never set, moving with different degrees of velocity, and nearly stationary.

Did you say, that there are some stars which never set?

Yes; they are those, which revolve about the polar star, and describe circles of greater circumferences according to their distances from that star. The stars, which revolve round the polar star, at no very considerable distance, are called circumpolar stars.

Is the polar star stationary then?

Not completely so; neither is it situated exactly in the pole, but about a degree and three quarters from it, that is, from a point, in which, if a star were situated, it would appear perfectly fixed; the general appearance, therefore, of the starry heavens, is that of a vast concave sphere, turning round two imaginary fixed points, diametrically opposite to each other, the one in the north, the other in the south; and this apparent revolution is performed, in about twenty-four hours.

I think I already understand, that the stars habitually retain the same relative position with respect to each other, though now I think you say they move all together.

Exactly so; hence they are called fixed stars, in opposition to the planets, which, like our earth, are continually changing their places, both with regard to the fixed stars, and to themselves also.

Now will you tell me, how I may discover any of the constellations?

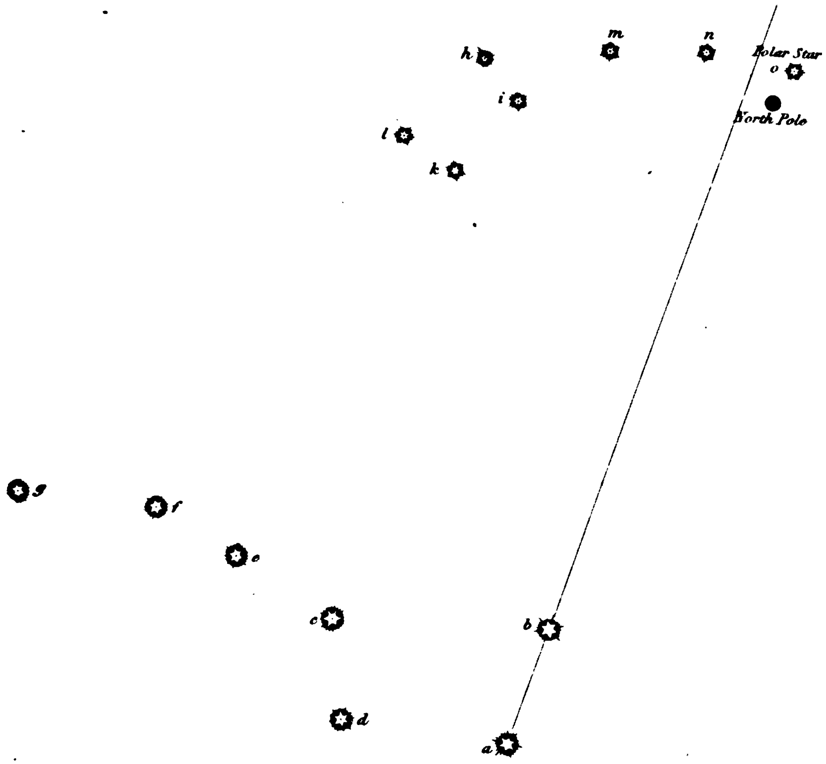
Yes: if you face the north, you will perceive, that Ursa Major is the most conspicuous constellation in the heavens. It is visible at all times, when there are any stars to be seen. I will make you a small drawing of the Great and Little Bears, representing Ursa Major below the pole.

I have heard that there are some stars in this constellation, called Pointers; which are they?

They are the two stars marked *a* and *b*, and they derive their names from the circumstance of their pointing to the north pole. You will observe, that the polar star, is rather to the right of the line, passing through *a* and *b*. We can now make use of these stars as a kind of standard, in order to discover the names and positions of others in the heavens: thus, conceive a line drawn from the star *i*, and passing to the left through the star *l*, and it will pass through that brilliant star, near the horizon, towards the west.

I see the star; but how am I to know its name?

Ursa Major and Minor.



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We will go into the alcove, and look at the celestial globe for the stars *i* and *l:* we must suppose a line drawn on the globe, as we conceived it done in the heavens, and we shall find the star and its name.

The name, I see, is Arcturus.

Now look at your figure, write the word Arcturus at A, which is its relative position in respect to these two constellations. If you conceive a line drawn from *g* passing between *b* and *a* in Ursa Major, and extended a good way to the right, it will pass just above another very brilliant star. Examine the globe, and find its name.

It is Capella, the Goat.

If we conceive a straight line drawn from the left of the polar star, through the two stars of the Great Bear, which, in your figure, are marked *b* and *a*, and suppose it to extend a good way down, it will pass, or nearly pass, through a very bright star, though not so bright as Arcturus or Capella. What is that called?

By referring to the celestial globe, I find it is called Regulus, or Cor Leonis, the Lion's Heart. But I see, that between Regulus and Ursa Major, Leo Minor is situated: I should just like to see how that looks in the heavens.

Well, step and see; and at the same time you may observe, that the tail of Draco lies between the polar star, and the square of the

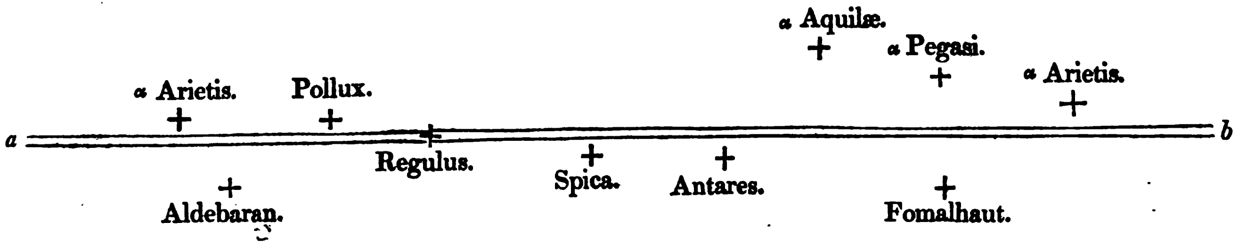
Great Bear. The figure extends in a serpentine direction towards the left hand, where it is terminated by four bright stars, in the head, forming nearly a square. When you were looking at Regulus, did you observe it forms one of four bright stars in the body of Leo Major? Regulus is the one nearest the south, and is remarkable for its situation, which is on the ecliptic.

The ecliptic may easily be traced on the celestial globe. Can we trace the circle of the ecliptic in the heavens?

It may be done with tolerable accuracy by two methods: first, by observing several remarkable fixed stars, to which the moon in its course seems to approach; the second method is by observing the places of the planets.

How can we trace this line by help of the fixed stars?

By comparing the stars in the heavens with their representatives on the artificial globe. I will mention to you the names of those stars; and you may first find them on the globe, and then refer to as many of them as are now visible in the heavens. The first is in the Ram's Horn, and is called α Arietis, about ten degrees to the north of the ecliptic; the second is the star Aldebaran in the Bull's Eye, six degrees south of the ecliptic. You may cast your eye on the following sketch, while I proceed.



a b the ecliptic, with nine stars so near the moon's path, that her distance from any one of them is calculated for every three hours of time for many years to come.

Then, if at any time I see these two stars, I know that the ecliptic runs between them, and nearer to Aldebaran, than to that in the Ram's horn?

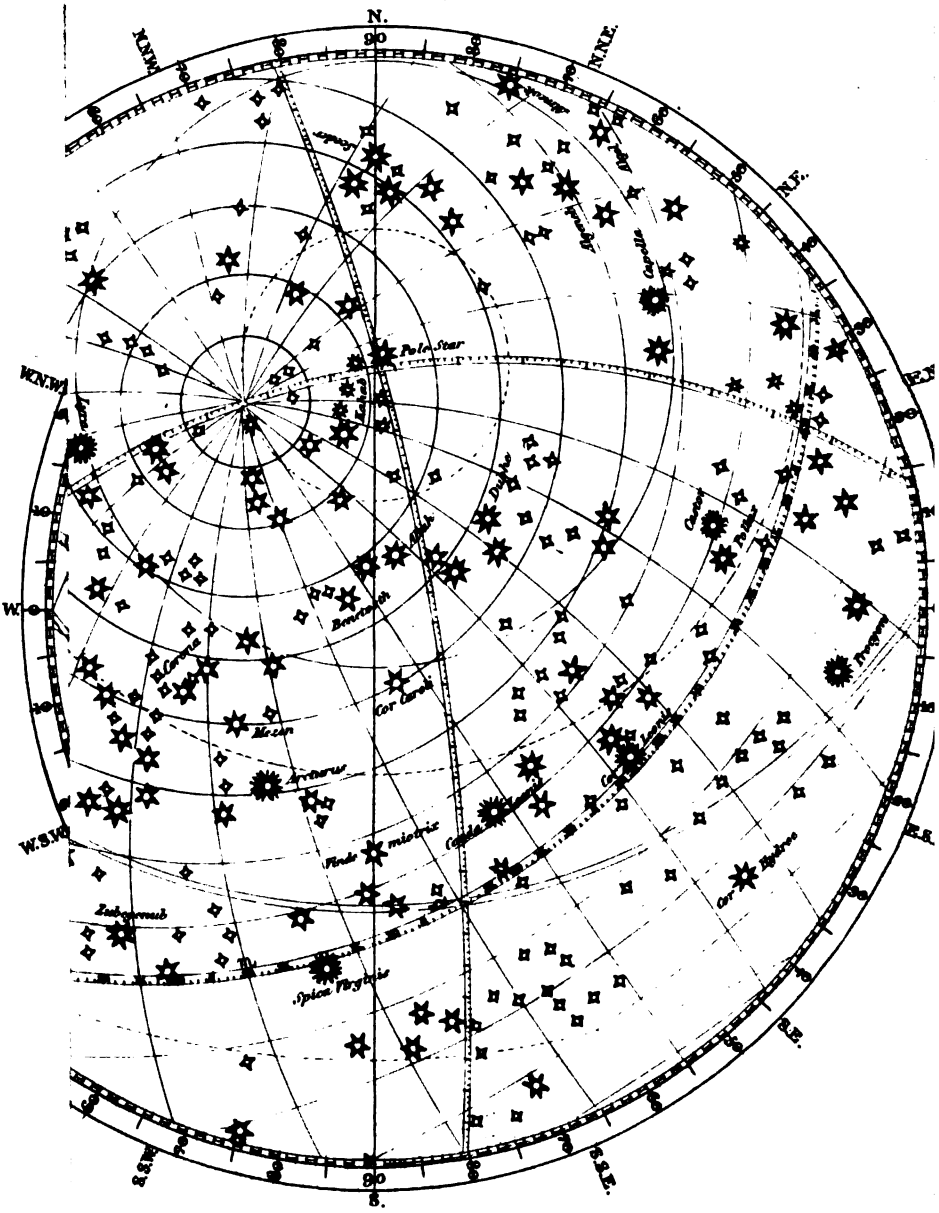
Yes: now carry your eye eastward to a distance somewhat greater from Aldebaran, than that is east of α Arietis, and you will perceive two bright stars at a small distance from one another, called Castor, and Pollux; the lower one, and that which is least brilliant, is Pollux; seven degrees on the north side of the ecliptic. Following the same track, you will come to Regulus, or the Cor Leonis. Beyond this, and only two degrees south of this line, you will find the beautiful star in the Virgin's Hand, called Spica Virginis. You then arrive at Antares, or the Scorpion's Heart, five degrees on the same side the ecliptic. Afterwards, you will find α Aquilæ, which is situated nearly thirty degrees north of the ecliptic; and farther on is the star Fomalhaut, in the Fish's mouth, about as many degrees south of that line. The ninth, and last of these stars is Pegasus, in the wing of the Flying Horse, which is north of the ecliptic, nearly twenty degrees.

Upon what account are these stars particularly noticed?

They are selected as the most conspicuous stars near the moon's orbit, and are considered

FACE of the HEAVENS
in the
MIDDLE OF MAY,

At nine in the Evening.



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as proper stations, from which the moon's distance is calculated for every three hours of time, and hence are constructed those tables in the Nautical Almanacks, by means of which navigators, in their most distant voyages, are enabled to estimate, on the trackless ocean, the particular part of the globe on which they are.

Now, mamma, I wish to ask you, if the same stars would present themselves to our view at the same hour every night, if the weather were favourable?

No: if you will frequently look at the heavens at nine o'clock, three or four months will be a period, sufficiently long, for you to observe a considerable difference in their appearance.

How do you account for that?

Tell me first the reason, why the heavens appear to undergo a continual change, while we sit in the alcove with our faces to the south.

This apparent motion of the stars, I suppose, arises from the real motion of the earth; but still there is something I do not understand; for I should have thought that the diurnal motion of the earth would have brought it round to the same fixed point, every twenty-four hours.

Do you then forget, that the earth has a compound motion, and is marching onward in its orblt with such a velocity, that the same alteration, in the aspect of the heavens, may be observed in the course of a year, as presents itself in the course of twenty-four hours; for instance, if you look at Capella, on any evening at six o'clock, and again at midnight, it will, during these six hours, appear to have advanced a quarter of its circuit; and, at six the next morning, will be exactly opposite the station, in which it was twelve hours before. In like manner, by attending to the same star in January, we shall see her near the meridian at the lower part of the circle of perpetual apparition. In April, it appears to have advanced a quarter of this circle in its progress round the polar star; and, in July, to have moved half round, being just opposite to its situation in January.

Then it seems to me, that the progress which the earth makes in its orbit in a fortnight, presents as great a variety in the aspect of the heavens, as the rotation on its axis causes in a single hour.

Let me hear how you make that out.

If twelve hours of diurnal rotation, exactly coincide with six months of their annual revolution, and six hours of the former, with three months of the latter, and two hours with one month; then it follows, of course, that one hour's rotation will coincide with the earth's revolution during a fortnight. How much I should like to make some maps to express these changes!

We will see what we can do towards the production of some in a few days.

But could you not, on the present occasion, just tell me the different appearances of the heavens, at the present time, the month of May, and during the month of January?

I will do that, if you will help me.

I wish I could.

Well; let me see if I cannot put you in the way of doing so.—Carry the globe into the garden, elevate the pole to the latitude of the place, and set the globe due north, and south, by a meridian line. Find the sun's place in the ecliptic, bring it to the brass meridian, and set the index of the hour circle to twelve; then, as it is past noon, turn the globe westward on its axis, till the index has passed over as many hours as the time has gone beyond noon. Now fix the globe in this position, then the flat end of a pencil being placed on any star on the globe, so as to point towards the centre, the other end will point to any particular star in the heavens.

Of this rule I will avail myself, when you are not present, my dear mamma. Will you now tell me, what I see?

Inform me first how many constellations you know?

Ursa Major, and Ursa Minor; Leo Major, and Leo Minor; with Draco, Arcturus, and Capella.

Now, then, we will extend the line drawn from the polar star through Regulus, and that will pass through the Heart of Hydra.

To the right of Cor Hydræ, near the horizon, and a little more distant than Regulus, I can see a bright star; will you favour me with its name?

You had better retain your own description of it in your memory, while you run, and look on the globe: then bring me word what it is called.

It is Procyon in Canis Minor.

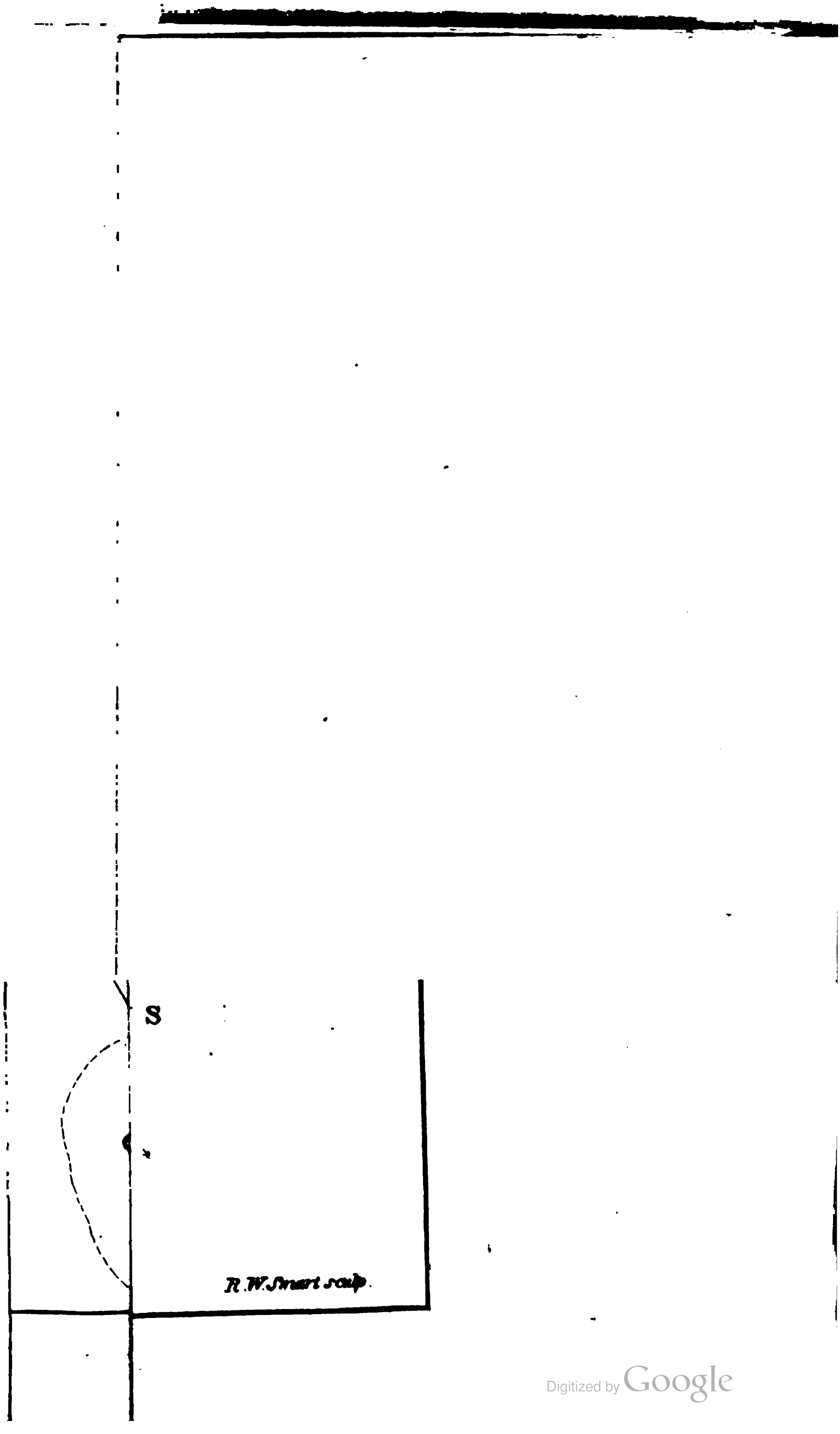
Now look to an equal distance to the left, and you will see about ten stars. They are the most conspicuous in Crater, the Cup; beyond which, in the same direction, is Corvus the Crow.

I discern two stars, the names of which I should like to know, if I could describe their situation to you; I will try.—Suppose a line to be drawn through b *and* c *in the Great Bear, and to proceed onwards towards the south.*

You refer, I dare say, to the stars Cor Caroli and Spica Virginis. Look on the globe; am I right?

Perfectly.

Now observe, that Spica, Arcturus, and Deneb, form an equilateral triangle. You can tell me, in what constellation I may find these stars.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Yes; Spica is in Virgo, Arcturus in Boötes, and Deneb in the Lion's tail.

A line connecting *l* and *h* in the body of the Little Bear, and brought through Cor Caroli, would fall on Coma Berenices.

Ah! I see it, it looks of an oval form; three of the stars are very bright.

Yes; that is the case: this constellation is composed of eight stars not far removed from each other. Direct your attention now to Arcturus; suppose a line to be drawn through that star, and Coma Berenices, it will pass through the body of Hercules, beyond which, in the same direction, is the bright star Viga in Lyra.

But between Hercules, and Arcturus, there is a considerable space. What constellations find a place there?

Corona is north, and Serpens south of Arcturus, but they are situated between it and Hercules. Viga in Lyra, Altair in the Eagle, and the head of the Dolphin, form an isosceles triangle.

But I do not know any thing about Altair, or the Dolphin.

They may each be easily distinguished; Delphinus consisting of four stars nearly united, and one at rather a greater distance; Altair is the centre of three bright stars, situated near to each other in a straight line; above the Dolphin is Cygnus, a remarkable constellation in the milky way; below which is Pegasus.

But still there remain a great many constellations, which I well know on the artificial globe, and which you have not yet pointed out to me.

Perhaps they are those, which adorn the heavens in the month of January, such as the Pleiades, Auriga, and Orion.

O yes; those are the constellations to which I refer.

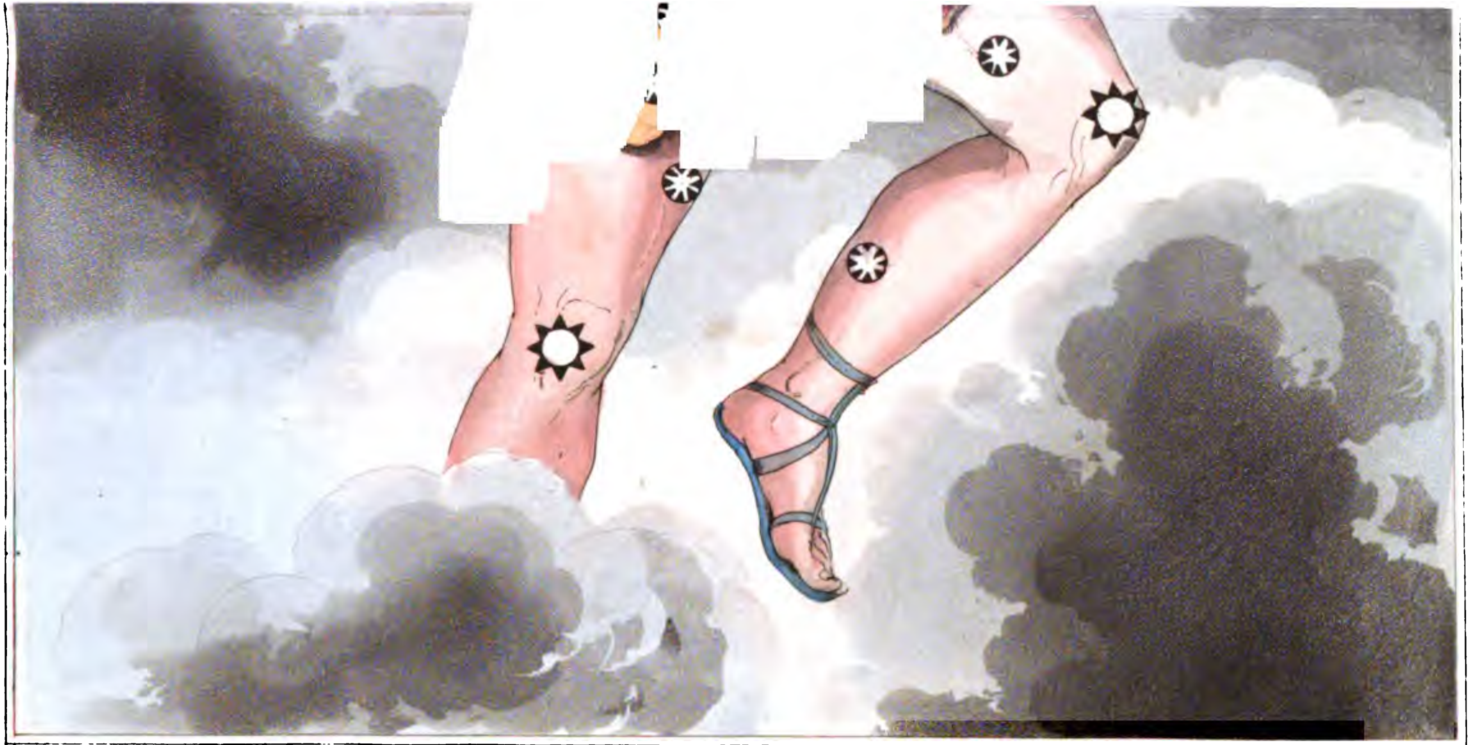
Well, then, at ten o'clock in the evening, in the month of January, you may perceive towards the south the Pleiades, to the left of which, and a little lower, are Aldebaran and the Hyades; farther to the left, and a little higher than the Pleiades, is the remarkable constellation Auriga.

How shall I know that, mamma?

It has exactly the appearance of the figure which I have in my hand. The highest star towards the left hand is Capella, the star marked β and γ is situated in the Bull's north horn, and also in the right heel of Auriga.

Can you contrive to join this to my favourite Orion?

Imagine a line to be drawn from Capella, through the stars at the tips of the Bull's horns, extended onwards to the horizon, and it will pass the middle of that constellation. Surely you can arrange these stars from recollection,



C. V. Whitwell del.

Orion (2)

and then I will contrive an original figure, which shall include them But to proceed: at about the distance of 26 degrees from Betelgeux, which is the star in Orion's right shoulder, is Procyon, a star in Canis Minor. Between Betelgeux, and Procyon, and nearer to the horizon, is Sirius. These three stars form an equilateral triangle.

What stars will then make their appearance to the left of Auriga?

There you will see Castor and Pollux in Gemini. There will be four stars in a line between Betelgeux and Castor. These constitute the four feet of Gemini.

Where will Perseus be situated?

To the right hand of Auriga, and above the Pleiades. In a line with Castor, and Capella, is Algenib, a bright star in the breast of Perseus; and, further to the right, is Almaac in Andromeda. These two stars, with Algol in the Head of Medusa, form a triangle, of which Algol is the nearest to the Pleiades. Imagine a line to be drawn from the Pleiades, through Algol, and it will pass through Cassiopea.

Ah, I have heard, that it looks like the capital letter W.

To the right hand of the Pleiades, at a considerable distance, is α Arietis, a star not very brilliant; a line drawn from the Pleiades, through this star, will pass through Markab in Pegasus.

Do not the principal stars in this constellation form a square?

A large square is formed by its three principal stars, and the star in the head of Andromeda.

It must now be very late. Let us return to the house.

O mamma, leave these ten thousand lamps, for one or two little tapers, all this mental improvement, for sleep and insensibility!

My child,

> "th' hour
> Of night, and all things now retir'd to rest,
> Mind us of like repose; since God hath set
> Labour and rest, as day and night, to man
> Successive: and the timely dew of sleep,
> Now falling with soft slumbrous weight, inclines
> Our eyelids. Other creatures all day long
> Rove idle unemploy'd, and less need rest.
> Man hath his daily work, of body or mind
> Appointed, which declares his dignity,
> And the regard of Heav'n on all his ways;
> While other animals unactive range,
> And of their doings God takes no account.
> To-morrow, ere fresh morning streak the east
> With first approach of light, we must be risen."

Ah, mamma, I know who says all that; may I use the same author's words, and ask you an interesting question, that I may hear you repeat his reply?

Let me hear the question.

> *" Wherefore all night long shine these? for whom*
> *This glorious sight, when sleep hath shut all eyes?"*

Since you wish it, I will give you Milton's answer.

> " These have their course to finish round the earth
> By morrow evening; and from land to land,
> In order, though to nations yet unborn,
> Minist'ring light prepar'd, they set and rise;
> Lest total darkness should by night regain
> Her old possession, and extinguish life
> In nature and all things: which these soft fires
> Not only enlighten, but, with kindly heat
> Of various influence, foment and warm,
> Temper or nourish; or in part shed down
> Their stellar virtue on all kinds that grow
> On earth, made hereby apter to receive
> Perfection from the sun's more potent ray.
> These then, though unbeheld in deep of night,
> Shine not in vain; nor think, though men were none,
> That Heav'n would want spectators, God want praise:
> Millions of spiritual creatures walk the earth
> Unseen, both when we wake, and when we sleep.
> All these with ceaseless praise his works behold,
> Both day and night. How often from the steep
> Of echoing hill or thicket, have we heard
> Celestial voices to the midnight air,
> Sole, or responsive to each other's note,
> Singing their great Creator? Oft in bands,
> While they keep watch, or nightly rounding walk
> With heavenly touch of instrumental sounds,
> In full harmonic number join'd, their songs
> Divide the night, and lift our thoughts to heav'n."

CHAPTER XIV.

THE ANTIQUITY OF THE CHALDEAN ASTRONOMY.

Mamma, you did a long time ago say, that you had much to communicate to me respecting the antiquity of the Chaldean astronomy. Will you tell me something now?

The request implies a willingness to attend. Give me the best effort of your mind, and I will begin.

All my communications I wish to be made in the most intelligible form: on the present occasion nothing could be more easy, than to bewilder the youthful mind, without arriving at any satisfactory conclusion; for all that human ingenuity can do to perplex in chronological calculations, has been done. You well know the calm determination of my mind, to take the Bible as my guide on all subjects, on which it professes to afford assistance.

But you told me once, not to look upon the Bible as a guide in astronomical investigations.

I once observed to you, that the astronomical phraseology in the Bible was employed in unison with the opinions of the people, among whom they were delivered, and that it would have been as unwise, as it would have been impossible, at the time, to have entered upon long philosophical disquisitions, as a necessary defence, for the deviations from the common opinion of the people addressed. But what I am about to propose to you now is widely different. I allude to the historical records of Moses, a history as free from conformity to the prejudices of the people to whom it was delivered, as *the whole scheme of the Bible* is opposed to the opinions of a giddy world: a history of such commanding importance, that, if it be not duly appreciated, the main pillar of Christianity is shaken, and the whole building must fall to the ground.

But, if the chronology of Moses were found to be inaccurate, would that materially affect the other records he has given, in the first three chapters of Genesis, when he has not specified the period of the occurrence of events?

In exact proportion, as the detached parts of the edifice are secure, will the fabric stand. It is hard to say how weak, how imbecile, how inactive, how full of wounds, of distortions, of infirmities, of detestable vices, and of littleness of intellect, the human frame may be, and yet retain the appellation, man; but this we know, that the Being, whom we recognise with delight, in whose appropriation of the title, we glory, is one destitute of all these deteriorating considerations. So of the Bible, it is hard to say, what we might resign, in how many minute circumstances it might err, and yet continue our infallible guide of faith and practice; but the Christian, clasping the Bible to his grateful heart, had rather, with a well-earned confidence, exclaim, "Thy word is truth."

Am I then to understand, that you wish me to accept of the Mosaic history as perfectly correct?

Yes; for, though it differs materially from the boasted computations of the Chinese, the Persians, and the Hindoos, yet their statements must only be regarded as the romantic dreams of astronomical mythology. And many of their assertions are so obviously false, as to defeat their own object. The Hindoos assert, that the Saturnian age consisted of seven hundred, and twenty thousand years. The Egyptians, but little behind them in arrogant pretensions, were detected, when Alexander entered Egypt with his victorious army; for they not only kept records of their own antiquity, but those of other nations also, and among the rest those of the Macedonian empire. This they represented as having existed eight thousand years, while Alexander well knew, that it had not existed quite five centuries. If they would thus augment the records of another nation, what would they do with regard to their own?

But I have heard much respecting the antiquity of the Chinese: perhaps before we proceed further, you can show me, that their immense calculations are not inconsistent with the history, and chronology, of the Scriptures?

I will give you an illustration. The Chinese have ever made a point of inserting in their calendars remarkable eclipses, or conjunctions of the planets, together with the name of the emperor, in whose reign they were observed. To the events they have also affixed their own dates. A very singular conjunction of the sun, and moon, and several planets, is recorded in their annals, as having taken place almost at the very commencement of their remote history. The justly famed Cassini, to ascertain the fact, calculated back, and decisively proved that such an extraordinary conjunction did actually happen in China, on February 26th, two thousand and twelve years before Christ. This falls four hundred years after the flood, a little after the birth of Abraham. Hence, their pretensions to antiquity, beyond the period assigned by Moses, for the existence of an ancient nation, are unfounded. And the fact is, that all the accounts, respecting the number of years which ancient empires are said to have flourished, must be unintelligible to us, because among the ancients the meaning of the term year, so exceedingly varied.

I am now fully prepared to receive any histo-

rical assertion made by Moses. Will any thing, which he says, confirm the assertion, that astronomy was first studied in Chaldea?

Moses says[*], "The ark rested upon the mountain of Ararat." You will observe the use I make of this information. Mount Ararat, is situated between the Euxine, and Caspian seas. The statements of modern travellers illustrate the fact recorded in the fifth verse: read it, my child.

"*And the waters decreased continually, until the tenth month: in the tenth month, on the first day of the month, were the tops of the mountains seen*[†]."

That is, the tops of Mount Ararat were seen; for they inform us, that this one mountain, with two summits, when compared with Mount Taurus and the Caucasus, is of extraordinary height. Now, read from the fourteenth to the nineteenth verse.

"*And in the second month, on the seven-and-twentieth day of the month, was the earth dried. And God spake unto Noah, saying, Go forth of the ark, thou, and thy wife, and thy sons, and thy sons' wives with thee. Bring forth with thee every living thing of all flesh, both fowl, and of cattle, and of every creeping thing that creepeth upon the earth; that they may be fruitful, and multiply upon the earth. And Noah went forth,*

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[*] Genesis, viii. 4.

[†] Genesis, viii. 5.

and his sons, and his wife, and his sons' wives with him. Every beast, every creeping thing, and every fowl, and whatsoever creepeth upon the earth after their kind, went forth out of the ark."

The first observation I make is, that the reserved family would certainly reside, in the neighbourhood of these mountains for many years. But we find, that with revolving periods of time, the impression, made on their minds by the scenes they had witnessed, wore away; and we read, " they journeyed from the east*."

For how long a period do you think they dwelt in the neighbourhood of the place, where the ark rested?

About 140 years: and my second observation is, that they could not have been idle during that period.

No; I think not so long as that.

The record we have of them does not convey this idea. The very next words after we are told, " Noah came out of the ark, &c." present us with a scene of active piety. " And Noah builded an altar unto the Lord, and took of every clean beast, and of every clean fowl, and offered burnt offerings on the altar." No; idle, they could not be. I cannot conceive a state of mind more enviable than that, which the rescued family must have experienced. All the passions hushed to silence, all indifference to God for ever banished, the heart deeply impressed with the necessity of personal and serious religion, all obduracy of mind removed. No presumptuous thoughts of a God all mercy, but with an insight into the infinite purity, and extent of his acquirements, and the corrupted state of all the faculties of the soul; a heavenly and transcendent tenderness marked every action, a peaceful glow of devotion, which the advanced Christian can alone understand, rested on the soul, raising it at times into a fervour of gratitude to God, which no language can depict, which no eloquence can portray. No; language must have assumed an unusual character, when, on the one hand, it was excited by a view of a country depopulated, and burdened, with the mournful remains of its unworthy inhabitants, and, on the other, by the sight of the ark of their preservation. Surely then a chastened joy, a filial fear, a reverential love, an active devotion, marked all their conduct.

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* Genesis, xi. 3.

What, do you think, then, that gratitude to God, and love to each other, prevent people from being idle?

No stimulant to industry is half so powerful. And since Noah, and his family, were not indolent, I must direct you to the channels, in which their energy flowed. We must remember, that the earth was, indeed, an abode of desolation; that Noah had no shelter, but what the ark afforded, and no food, but what his own hand provided.

O! you cannot think, how I feel for this good family.

Well! the next circumstance after Noah had built an altar is, that God makes a very tender covenant with him. Then immediately follows, "And Noah began to be an husbandman;" and, presently afterwards, we find these words, "he was within his tent." So that we see another sheltering roof provided, and a very important art, already the object of attention. Now, I must tell you something more, that they had no guide at all in the culture of their fields, in the sowing of their grain, in the planting of their vines, in their arrangements concerning their cattle, but what they derived from a minute attention to the heavenly bodies. Since, for a long time, they were strangers to the thousand artificial wants, which society creates, we may presume their days glided most sweetly over their heads, devoted to innocence and love. So that many hours of the night, might without inconvenience, be dedicated, beneath a serene and transparent sky, and amidst the green, and beautiful vales of their retreat, to the contemplation of the starry firmament, to observations on the aspects of the moon, and on the oppositions and conjunctions of the planets. This, indeed, is certainly one of the causes, to which we must ascribe the unparalleled advancement made by the Chaldeans in their astronomical researches.

Yes, mamma, I do think, they must have felt, all desolate as they were, a peculiar pleasure in casting their eyes, where they sometimes saw, the bow of promise mildly resplendent. But you say, this is certainly one of the causes of the advancement made by the Chaldeans; will you tell me, what you consider another cause?

With great pleasure. You must recollect then, that the flood did not descend upon Noah without a long previous notice; it descended not till this notice had been long most firmly believed. Acting habitually under this conviction, would he not preserve documents, and monuments the most valuable and important? would he not educate his sons for such an event? Surely they were all walking libraries, the repositories of the sciences of the antediluvian world. What the unbelief, or the unfriendly disposition of their associates forbad them to preserve in the ark, think you, that they took it not at all? O no: it was secured in a retreat from which the art of man could not dislodge it. That, which they were not allowed to deposit in that sacred pavilion, they secured in the inner recesses of the mind. With what a fund of astronomical information then, must they have been furnished! for surely the lengthened lives of the antediluvians were favourable to numerous and accurate observations.

One thing has struck me since you have been speaking; how was it, that Noah landed so nearly at the spot, to which it might be presumed he was anxious to return, so near to the original destiny of man, so near to all that he had lately left?

No inquiry could be more appropriate, as an illustration of what I was advancing. How did the patriarch, and the pilot, direct his vessel, unless it was by his astronomical information? How is he most commonly represented on Egyptian monuments, but as a man sitting in a boat with a whip in his hand, descriptive of his twofold character of pilot and governor of the world: this boat is sometimes depicted on the shoulders of twelve men, probably emblematic of the twelve months.

Do you think it is at all probable, that the antediluvians had formed for themselves a sphere?

All I can say is, that, when I look on the two celestial hemispheres, as they at this moment hang before me, I cannot but be much astonished at the different appearances they present; so varied, that the one seems to be a representation of land animals, the other of marine objects; so dissimilar, that we cannot but conjecture, the one was formed by those who were unacquainted with the element of water, the other by those who were painfully intimate with the watery world. In fact, the two hemispheres seem to allude to the two grand events recorded in ancient history: the fall of man, and the general deluge. As opportunities for additional conversations present themselves, these observations will be illustrated. At this moment I will observe, that when I look on the northern hemisphere, and behold the malignant Draco, I see a fact much more momentous than that which the fabling Greeks have contrived, respecting the Hydra, which guarded the golden apples in the garden of the Hesperides. I see that old serpent, who deceived our first parents, and who was the means of excluding them, and their posterity, from paradise. When, indeed, I contemplate the veneration paid to serpents in ancient times, I behold infused into the minds of the people a belief of the superior address, the unusual wisdom of that reptile. And since he retains his place among the constellations, what is more likely, than that the Grecian Boötes, the Chaldean Noah, supplies the place of the antediluvian patriarch Adam? If a grateful church elevated her twelve Apostles to the honourable station of the zodiacal constellations, may we not suppose, that more grateful sons would elevate their immediate progenitor, he to whom they were indebted for their honourable preservation, to the place originally occupied by him, "who brought death into the world with all our woe?" This is only conjecture; but conjecture, supported by so many powerful considerations, has in it something of the nature of real history.

I should like to know the length of time, that intervened between the creation, and the deluge.

About 2500 years. And surely this was a period, sufficiently long for some progress to have been made in science. What have not 2000 years effected among us? but without doubt the lengthened lives of the antediluvians gave them the advantage. Their longevity implies greater original stamina, than those which we possess. The productions of a fertile soil; the invigorating influence of salubrious air, and serene sky, with the enjoyment of a perpetual equinox, might not only add to the period of their existence, but give to it a zest, an energy, to which we are in some degree strangers. And, if their lengthened lives in any degree arose from a purer atmosphere, it should be remembered, that this also was a circumstance favourable to celestial observations. Besides which, while the whole community were more vigorous, think you not, that some individuals rose pre-eminently high? Say, was there not a Pythagoras, or a Copernicus, yea, a Newton or a Herschel, in the antediluvian world? What, not one original genius, during two thousand five hundred years, not one whose ample vigour of intellect, whose comprehensiveness and liberality of mind, would surmount the ordinary standard, whose angelic ken would look forward on the slow advancements of succeeding ages? Besides which it must not be forgotten, that Adam was endowed with intellectual qualities far more extensive and vigorous than any of his posterity have since enjoyed. It is our lot to arrive by very slow advances, to any degree of superior wisdom and science; but it is possible, that he, who was appointed to replenish and subdue the earth, and to be the sovereign lord, both of its human and bestial inhabitants, was intuitively invested with faculties of reflecting, comparing, and judging, adequate to his important station, and proportionate to the extent of his dominion.

Do you think, mamma, that the antediluvians contrived any thing resembling our telescopes?

We have not the least evidence, that they had; the probability is, that all their acquaintance with celestial phænomena arose from unassisted observations; but, then, recollect, how favourably they were situated. So much so, that the great Khalif al Mamun caused observations on the celestial bodies to be made on this very plain, now called by the Arabians, Sin-jar, which served the astronomers of Europe for several ages after. And such, in truth, is the uninterrupted view of the heavens, which this vast and extensive plain affords, that the same spot was selected by Gelalidin Malek Shuh, the third sultan of the Seljukian dynasty, nearly three hundred years after. Such is the benefit of a clear atmosphere, that the elder Cassini, who observed the planet Venus in Italy, was enabled, in that country, to make discoveries, which his son afterwards in vain attempted to verify in the grosser one of Paris.

But do you not think it probable, that they had something resembling the art of writing, in use among us?

It is an universal tradition in the East, that Seth, Adam's son, invented certain marks expressive of ideas. If you will fetch me Josephus, I think, I could find you a passage, which would convince you, that the antediluvians had some method of recording their observations, and that they had made some progress in astronomy.

Here is the volume.

Now read.

" *The children of Seth were the inventors of that particular sort of wisdom, which relates to the heavenly bodies and their order. That their* *inventions might not be lost before they were sufficiently known, upon Adam's prediction, that the world was to be destroyed at one time by a deluge of water, and at another time by the violence of fire, they made two pillars, the one of brick and the other of stone; they inscribed their discoveries on both, that in case the pillar of brick should be destroyed by the flood, the pillar of stone might remain, and exhibit those discoveries to mankind, and also to inform them that there was another pillar of brick erected by them. Now, this remains in the land of Seriad to this day*."*

Since the Chaldeans were favoured with the observations of an older race of astronomers, I shall not be surprised to hear, that they made proficiency in this science. Will you oblige me with some evidence that they did?

It is highly probable, that, as the colony which migrated from Chaldea into Egypt, appropriated its pyramids to astronomical purposes, this was but in unison with the idea, originating in Chaldea, of dedicating the tower of Babel to that object; and their observations must have been numerous, before they could have wished for such a means of facilitating their progress in astronomy, and of transmitting their names, with all their well-earned honours, to posterity;

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* Josephus, lib. i, c. 2.

they had done so much, that they designed to leave behind them this memorial, and thus to live in the memory of their grateful posterity. Among the various titles * appropriated to Nimrod, there are those, which would lead us to suppose, that he was not only a mighty hunter, but an able astronomer. He was, we believe, not only the founder of the city, but of the tower of Babel, and was, on these accounts, much reverenced in Chaldea, the peculiar region of his sovereignty. It is generally believed, that the temple of Belus, that grand astronomical observatory, was erected upon the ruins of the tower of Babel, and that Babylon stood upon the spot, where the vast design of the descendants of Noah, was projected and partly executed by Nimrod.

And does it appear, that the Chaldeans preserved the art, of perpetuating the result of their researches?

There is the most satisfactory evidence for asserting that they did; for, when Alexander took Babylon, Callisthenes, on inquiry of the Chaldean priests of Belus, found, that they had a series of astronomical observations extending back, one thousand nine hundred and three years, engraven on bricks. This period carries us up very nearly to the time of the general dispersion of mankind.

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* Memorandum VIII.

Does it appear, that, at this early period, they had a correct opinion of the length of the year?

It was altogether impossible, that they could be acquainted with the length of the year as it now stands, since it does not agree with the course of the sun and moon as exactly now, as before the deluge.

Then, you think, the antediluvians were acquainted with this astronomical fact?

It is obvious, that each patriarch, mentioned by Moses, lived through so many revolving seasons, that unavoidably they must have ascertained the length of their year. It is remarkable, that the period, assigned by the Hebrew historians, for the duration of the deluge, amounts precisely to a year, and that year was the ancient lunisolar year, consisting of twelve months, of thirty days each.

It must, I suppose, have been a very considerable period, before they rectified their year to the sun's true course?

Yes; it was not for many hundred years after the deluge, that they extended their year beyond 360 days. The extent of the wall around the city of Babylon was 360 furlongs; for the post-diluvians had yet to learn the violence of the shock sustained by the earth at the deluge: to ascertain this, observations were yet to be multiplied; they were redoubled; and the result was, that, in Alexander's time, these walls were in circuit 365 furlongs, the addition coinciding with the days added to the ancient year. These diligent astronomers also formed a catalogue of the most conspicuous stars in the moon's path; these they denominated the luna zodia, or path of that luminary among the constellations. One of the strongest proofs of the proficiency of the Chaldeans in astronomy is exhibited in their famous cycle of eighteen years, afterwards attributed to Meto. They had likewise another grand period of sixty years, and a third lunisolar period of six hundred years. It is, I trust, obvious, from what has been said, that it was not in Egypt, nor in Persia, that astronomy first reared its head, but on the spot inhabited by the rescued family for about two centuries. There, as from a reservoir, flowed out the streams of astronomical science, which enriched, and guided, and directed, the people in all their migrations.

On a former occasion you said, that the descendants of Noah dwelt in the neighbourhood of the place, where the ark rested, for about one hundred and forty-four years: you now speak of about two centuries. How are the two statements to be reconciled?

Because it was after that period, that they journeyed from the east, and found a plain in the land of Shinar, and dwelt there, and made bricks, and burnt them thoroughly, and drew up a plan, and made some progress in building a city and a tower: for all this, I allow them the difference of time you have so properly remarked. For the purposes of husbandry the Chaldean shepherds, diligently studied astronomy. The principles and practice, thus cherished, were extended and amplified by the daring navigators of Phœnicia, and, in succeeding ages, by the philosophers of Persia, Egypt, and India, were carried to the utmost point of perfection attainable at those remote periods.

CHAPTER XV.

THE PRIMEVAL SYSTEM OF ASTRONOMY BROKEN BY THE DISPERSION OF THE PATRIARCHAL FAMILIES, AND CORRUPTED BY THE ALLEGORIES SO PREVALENT THROUGHOUT THE EAST.

In our last conversation, we left the inhabitants of the renovated world making progress in science, near the spot where the ark rested. Can you tell me the circumstance, which occasioned the separation of a people so tenderly bound together, as was the family of Noah?

It resulted from a miraculous change of language, which took place among them, in consequence of their building a city and a tower. But do you think, mamma, that this was improper?

The action, separately considered, certainly was not. But as it stands recorded by Moses, it called for a token of disapprobation, upon two accounts. Disobedience was its basis, and ambition would have been its topmost stone. The descendants of Noah had received a divine command to disperse themselves abroad, and thus "replenish the earth;" but this command had been but very partially obeyed. It is possible, that a few individuals might have migrated into China and India; but the general object was, to prevent such dispersions; for they said, "Let us build a city and a tower, lest we be scattered abroad." Disobedience was certainly improper; and a love of self, as much as a love of science, influenced them, when they said, "Let us build us a city and a tower, and let us make us a name." Ambition and self-love, are things, which God abhors, and which he has ever marked with the severest indications of his displeasure.

Do you not think the people were panic-struck by the new languages introduced among them?

I should apprehend something of the kind at first; but in the dispersion which ensued, I cannot conceive any thing like confusion, but simply a division, every individual uniting with the company that spake his language.

Will it be unseasonable for me to inquire, whither the descendants of Noah and their families migrated?

The concise statement I shall give you will not be an unsuitable digression. But I must assure you, that little can be said with certainty. Shem appears for the remainder of his days to have hovered about the plains of Shinar. From his descendants sprang the inhabitants of the lesser Asia, Mesopotamia, Persia, and China; comprehending the countries westward of Assyria, as far as the Mediterranean. Ham probably dwelt in Egypt. His descendants occupied Egypt, and Ethiopia, with the rest of Africa, Arabia, Phœnicia, and the land of Canaan. When Japheth left Babel, it is uncertain where he settled. His descendants dwelt in Phrygia, the eastern part of Asia Minor, Cappadocia, and Galatia. The circumstance of all nations having had one common origin, will account for the resemblances we meet with in their astronomical opinions; their having been so widely dispersed, will equally account for the observable dissimilarities.

Is there a considerable degree of resemblance in the zodiacs of different nations?

A sufficiency to evince, that their formers were conversant with one grand original plan. There is a sphere in the museum of the Barberini family at Rome, said to be that of the Egyptian Hermes, which, if authentic, contains the most ancient designations of the signs of the zodiac, and probably is a mixture of the rural calendar of Chaldea, with the astronomical calendar of Egypt.

How much I should like to see some astronomical designations purely Chaldean!

Yes: persons or things with which we have some acquaintance, are greatly endeared to us by distance of time, or place; but it is possible that you would be disappointed, were you to see a Chaldean zodiac; for, you know, these shepherd astronomers, attended to the celestial phænomena, in aid of the practice of husbandry. The vast and complicated system of mythology, afterwards formed upon its basis, was then unknown. The Sabian idolaters of Chaldea first corrupted, and rendered intricate, the system of astronomy.

The philosophical priests of Egypt, by converting into divinities the mundane elements, and embodying the children of the air, and fancy, increased the intricacy, and deepened the obscurity. The Greeks, in their ambitious design to be considered its inventors, buried its original history in entire oblivion, and concealed its allusions under an impenetrable veil of mystery, and fable.

What, then, is the Chaldean sphere, quite buried under the mighty edifice reared on its foundation?

No sphere, professedly Chaldaic, has come down to posterity; but, still it is probable, that their zodiac did not materially vary from that which has descended to us, and which is engraven on our globes. I will give you three highly respectable authorities for what has been advanced. M. Dupuis is decidedly of this opinion. He thinks that the ancients, by classing the stars of the zodiac, into twelve constellations, designed to form, for their own use, a rural, as well as an astronomical calendar, designating, by expressive symbols the various seasons of the revolving year. The Bull, and Virgo, or rather the Spike of ripe Corn, which formed the original asterism of Virgo, have, he conceives, been the zodiacal asterisms first delineated. Sir Isaac Newton says, "Now I hope on some other occasion to satisfy the public, as I have perfectly satisfied myself, that the practice of observing the stars began with the rudiments of civil society in the country of those whom we call Chaldeans, from which it was propagated into Egypt, India, Greece, Italy, and Scandinavia, before the reign of Sirac, or Sacya; who, by conquest, spread a new system of religion, and philosophy, from the Nile to the Ganges, about one thousand years before Christ; but that Chiron, and Atlas, were allegorical or mythological personages, and ought to have no place in the serious history of the human species." Sir William Jones is of opinion, that the Indian division of the zodiac, was not borrowed from the Greeks, or Arabians, but was known to that country from time immemorial, and that being the same in part, with the zodiac in use, among other nations of the old Hindoo race, the Chaldeans, and Persians, it was probably invented by the progenitors of that race before their dispersion.—And since it could not be borrowed from either the Arabs, or Greeks, and since its solar division in India is the same in substance with that used in Greece, he thinks it more reasonable to conclude, that both Greeks, and Hindoos, received it from an older nation, who first gave names to the luminaries of heaven, and from whom both Greeks, and Hindoos, as their similarity of language and religion fully evinces, had a common descent. Sir William Jones proceeds to inform us, that the Indian, like the European astronomers, divide a great circle into three hundred and sixty degrees, called by them portions, of which they, like us, allot thirty to each sign.

Will you tell me the names of the twelve signs?

Mésha, the Ram.
Vrĭsha, the Bull.
Mit' huna, the Pair.
Carcatí, the Crab.
Sinha, the Lion.
Canyà, the Virgin.
Tulà, the Balance.
Vrĭshchica, the Scorpion.
Dhanus, the Bow.
Macara, the Sea Monster.
Cumbha, the Ewer.
Mína, the Fish.

Surely the order, in which the signs of this zodiac succeed each other, corresponds with the regular return of the seasons, as they took place in a temperate clime, almost equally distant from the equator as from the poles; from Egypt, as from Siberia.

Are the Chinese so remotely situated, that no *connexion, in their astronomical views, can be traced with those of other nations?*

No: the Chaldeans, Indians, and Chinese, had each, in their system of astronomy, their grand period of sixty years, and the lunisolar period, of six hundred years. Between them and the Arabians, there is also a remarkable instance of similarity. Each of these four nations has its lunar zodiac, a division of the heavens unknown in all the systems of European astronomy.

What do you mean, mamma, by a lunar zodiac?

The moon's path around the earth. So attentively had the stars, to which she approached, been marked by the astronomers of these ancient nations, that twenty-eight mansions, or houses, were appropriated for her reception, during the twenty-eight nights of her revolution.

How remarkably attentive they must have been to her vicissitudes!

Their attention originated in a very important reason.

Favour me with it.

They formed their computations by the revolutions of that luminary. It is, indeed, obvious, that, in the infancy of science, a body so near the earth, and so swift in her motions, must have been particularly valued in the calculation of time.

When reading, the other day, Captain Wilson's voyage, and shipwreck, on the Pelew Islands, I smiled, when I saw the king's inquiry, how many moons it would be before he should see his son again?

That inquiry resulted from the inhabitants of that uncivilized island reckoning their time by months, and not by years. But, in some Indian astronomical books, we find, that the first year consisted not of a month, but only of a fortnight.

From what could that arise?

It might arise from two causes; they might reckon their time by the light, and dark sides of the moon, and so make one of our months consist of two parts; or, they might double seven days, for the sake of more rapidly computing by the immemorial custom, of dividing time into weeks.

What was the origin of this division?

Doubtless an ancient tradition of the time employed in creating the world. An interesting fact, respecting the astronomy of the Chinese, I should like to mention to you, though it is an instance of dissimilarity.

Pray do, my dear mamma.

They assign four of the constellations in the lunar zodiac to each of the seven planets, so that the year always begins in the same planet. They also include in them all the stars which are in the heavens; as well those, that lie within our solar zodiac, as those that lie beyond it.

I am glad you have told me this; for, though the whole statement is a peculiarity applicable only to the Chinese, yet their respectful attention to the planets is similar to that of other nations. Have you not informed me, that, in India, a planet was believed to preside over every day, and has not this opinion given names to the days of our weeks?

Since you recollect these facts, perhaps you will gratify me yet more, by an enumeration of those names.

Saturday, Sunday, and Monday, plainly denote Saturn's day, the sun's day, and the moon's day; and Tuesday, Wednesday, Thursday, and Friday, are the days of Tuisco, Woden, Thor, and Friga, which are the Saxon names for Mars, Mercury, Jupiter, and Venus.

But not only did a planetary genius preside over every day in the week, but the twelve months in Chaldea, Egypt, and India, had a separate deity assigned to each. In the same way as names were given to the planets, so to each of these deities an appellation was affixed: and it is very interesting to find, that the last but one of the Indian personages is Meetra; and Mr. Halhed informs us, that the Mithra, or solar genius of the Persians, is the same person.

This certainly evinces a close connexion between the nations of India, and Persia, or that they derived their ideas from the same source.

A similar division we find existing among the Greeks, in the selection of their principal gods, which are nothing but the powers of nature, and particularly the active fructifying energy of the solar beam personified; and how closely the Romans, copied the Greeks, in their conceptions of their national gods is obvious; for they actually personified the months, so that temples were dedicated, and altars flamed, to the genii of the twelve months in Rome, and even a feast was instituted by Augustus to their honour.

Will you point out to me, mamma, any further circumstances of similarity in the astronomical opinions of ancient nations?

I must not neglect to inform you, that the Chinese also divide their solar zodiac into twelve parts: the mouse, the ox or cow, the tiger, the hare, the dragon, the serpent, the horse, the sheep, the monkey, the cock or hen, the dog, and the boar. Here the ox, and the sheep, resemble those of the oriental zodiacs; the hare, the dragon, the serpent, the horse, and the dog, are all to be met with among the forty-eight constellations engraven on the most ancient sphere; the cock or hen, has probably relation to the old Babylonian asterism of the hen and chickens;

the monkey or ape of Hanumat, is a celebrated deity in the Indian mythology; and the boar has doubtless some allusion to the incarnate Veeshnu of that country.

I will now give you two illustrations of the fact, that the general principles, upon which the mythology of India and Egypt is founded, are nearly the same, although the objects, by which their conceptions are symbolized, vary. A remarkable instance presents itself in the case of the Egyptian Isis, in her lunar character, and of the Hindoo Chandra, or lunar orb. In Egypt, the moon's symbol was a cat; in India, the symbol of the satellite was a rabbit. One reason for the former symbol was the contraction and dilatation of the pupil of the eye, which they assert grows larger at the full of the moon, but decreases with her waning orb. The activity and vigilance of that animal during the night, the variegated colours which its spotted skin discloses to the view, and its astonishing fecundity, rendered the symbol appropriate. These latter peculiarities are equally exemplified in the rabbit of the Indian Chandra, and show a remarkable conformity of ideas in the two nations. An additional instance is furnished from the circumstance of the lion, so much abounding in the hieroglyphics of India, and conferring the illustrious title of Sing, on the families of her noblest Rajahs; at the same time, it is in a peculiar manner the object of Egyptian regard, because the Delta was inundated, when the sun entered Leo. A multitude of additional illustrations present themselves; but these will suffice as excitements to the perusal of larger works on the same subject.

CHAPTER XVI.

THE TWELVE SIGNS OF THE ZODIAC.

THAT there is no occasion to go to the hieroglyphics of Egypt for the origin of the solar asterisms, I have intimated in a former conversation. It was natural for the rural simple swain, observant of nature, and guided by her unvarying laws, to call this the season of the Ram, and that the season of the Kids, the original Gemini of the zodiac. The intense ardour of the sun, during a certain period of the year, would naturally enough be compared to some furious Lion, who marching from the desert might have ravaged his fields, or thinned his flock. To note the season of the solstices, and equinoxes, by animals and objects, descriptive of the oblique, or retrograde motion of the sun, would naturally occur to those, to whom those seasons were so important; and the autumnal, and brumal seasons, would be marked by objects, best illustrative of the vicissitudes of the atmosphere, and the corresponding occupations of the husbandman.

But I have some confused idea of your having read aloud a very different statement to this in

Bishop Warburton's Divine Legation of Moses. Will you allow me to fetch the book?

Certainly.

Here is the passage.—He says, "If things were to have names, which have not shapes, one would have supposed that the Egyptian heroes exclusively would have been so honoured. But the fact is, brute worship gave birth to the Egyptian asterisms. That they were an invention much later than the beginning of brute worship, is evident; for the multitude of stars, were not thus divided, till the Egyptian priests had made some considerable progress in astronomy; but brute worship was prior to the time of Moses, and nothing could be more in unison with the constant good policy of their priests, than a contrivance by which it was understood that their country gods had taken up their residence in the constellations. And their firm belief in the doctrine of transmigration, which led them to suppose that the same soul inhabited six or eight different bodies, was particularly favourable to the belief of the residence of their gods in the constellations."

To the full force of this passage I cannot accede. The zodiac is not entirely, though it may be partially, of Egyptian origin; and so it may be said of the constellations in general. They are partly Egyptian, partly Indian, and partly Chaldean; but, from whatsoever source derived, they were accommodated by the Greeks to their mythology. And in directing our judgment, with respect to the original formation of the constellations, we should always keep in mind, the local history, and prevailing habits, of the nations of the ancient world. This will be our best guide in assigning to them their proper inventors, and fabricators. Thus, all that are distinguished by a remarkable hieroglyphical cast, I am, says Mr. Maurice, for referring to the Egyptians; as the Draco or Polar Dragon, with its hairy head, like a bird of prey; Capricorn with the tail of a fish; and for the origin of the Triangle, we may look to the same people, on account of their close attention to geometrical pursuits.

Those that in a peculiar manner relate to the first great events of the postdiluvian world, and to agriculture, I should incline to conjecture were of Chaldean origin; as the Sacrificer, the Altar, and the Beast sacrificed, the Ram, the Bull, the Kids, or Persian Gemini. Those that more immediately concern navigation, to the Phœnicians; as the Ursa Minor, in which is the pole star; and the Ship, or Argo, as the Greeks called it. Considered in this point of view, the constellations will, in some degree, explain themselves; and since it is probable that the philosophers of every nation under heaven, elevated to the sky their favourite sovereigns, and greatest warriors, we must not wonder at the variety of the characters, or the occasional incongruity of the image. There were, however, certain grand and general features of primeval history, which appear prominent in all their systems of astronomical mythology. Picturesque emblems, relative to those stupendous and interesting events, the fall of man, and the universal deluge; and striking representations of the principal events which distinguished the life of the pious Noah, and those of the less virtuous chiefs of the great patriarchal family, especially the martial heroes of the Balic line, under multifold denominations usurp a considerable portion of the delineation on every sphere. These things being premised, I shall proceed to give you a short account of each of the constellations in the zodiac.

Aries is drawn on our sphere as a ram.—Was it thus designated by the ancients?

By the Egyptians it was described not by a bestial, but by a human, form; the head of which was decorated with two large ram's horns. The name was Amun.

To whom did they refer by this appellation?

To Jupiter Hammon, who was the first, and greatest of the Egyptian gods.

And who was Jupiter Hammon?

What a question! Should I answer it by telling you, they meant Ham, would you ask me, And who was Ham?

O no, I have arrived at home, when I get to *him; for I know he was the son of Noah; but if my multiplied inquiries can be pardoned, surely the mythology of the ancients will furnish an apology.*

Very well. Ham led the first colony from Chaldea to the banks of the Nile, and was there elevated, by the servile race, over whom he reigned, to divine honours.

How came the representation of Ham to be changed from a human to a bestial form?

The symbol of Jupiter, among the hieroglyphics of Egypt was a ram; and this zodiacal sign was probably brought into the country by the deified hero, to whom it was afterwards applied, this being the simple but significant asterism, on the rude sphere of a race devoted to agriculture, to denote the increase of their flock. But, if the Egyptians elevated a human form, the Greeks displaced it, and introduced the Ram. Nor must it be forgotten amidst the short sketches of Grecian mythology, which I shall give you, that the Greeks were composed of colonies from Egypt and Phœnicia, who mixing with the former stragglers who went thither, built towns, and formed independent communities. These eastern emigrants brought with them many traditions, which, being afterwards blended with early Grecian history, became the copious sources of mythology. The first sign of the zodiac will illustrate what I have said.

Are you, mamma, going to tell me the Grecian story?

Yes, in a very few words. The Greeks were not the only emigrants from Egypt; but among that number we may place the inhabitants of Colchis, situated east of the Euxine. This place was famous for most beautiful fleeces of wool. A certain ram of immense value had, it appears, been promised to Phryxus, a Grecian, but this he did not obtain without considerable loss, and then he had not the fleece of the animal in his possession; but having sacrificed the animal to Jupiter, he returned home, leaving the fleece, called "the golden fleece," from its exquisite colour, in the most lovely and retired part of a hallowed grove in Colchis; and, that no one might have access to this treasure, it was guarded by brazen-footed bulls, breathing fire, and by a vast and watchful dragon. When affairs were in this state, Jason, the future king of Thessaly, was born. His father dying, while he was yet an infant, the cares of government for a time devolved upon his uncle. But, when arrived at years of maturity, he demanded possession of the crown. Instead of complying with a request so natural, his uncle urged him first to prove himself worthy of such an honour, by fetching the golden fleece from the grove of Colchis. The undaunted courage of Jason supported him, and he resolved to perform a task so hard. He fitted out a ship, chose resolute companions, and succeeded in his attempt. This is the famous Argonautic expedition, to which I have occasionally alluded. With regard to the ship, the Argo of our sphere, I ought not to omit mentioning, that some writers, from the Hebrew word, Seraph, signifying at once a serpent, and a seraph, have conceived the fable of the dragon, vomiting flames, and guarding the golden apples of the Hesperides, to be founded upon the circumstance related in the Bible, that on the expulsion of Adam from Paradise, God placed a flaming band of cherubim, or seraphim, at the eastern gate, whose bodies moved every way, and, glittering like the vibrations of a flaming sword, guarded the approach to that lovely, but forbidden retreat. Dragons, fiery or vomiting flames, are always ready upon occasions like these, to execute similar offices of guardian vigilance in the Pagan theology, though sometimes the task is assigned to brazen-footed bulls, which may possibly be allusive to the name of cherubim (the word cherub signifying to plough, and we know that the cherubim are generally designated as oxen), bulls equally breathing fire *.

The second asterism is the Bull. Of whom is he a symbol?

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* Maurice's History of Hindoostan.

Of Osiris, the great Egyptian deity; who, understood morally, is the good principle; but physically, is the vivifying beam, which emanating from the solar orb, fertilized Egypt after the annual inundation. The horns are the emblems of that beam, as those of the female are of the lunar glory. But, though the Bull is the symbol of Osiris, on an older sphere it had a reference to another character. In the Chaldean sphere, it was the hieroglyphic character of the season of tillage, and of Noah the planter of the first vineyard. At the same time, the sun, the source of light and genial fertility, was not forgotten; hence all persons distinguished by their splendid talents, and superior beneficence, have been compared to the sun, and have by their respective nations been advanced to this constellation. But, what a cloud of mystery the application of the same name to different individuals, and to different objects, has brought upon history, you cannot conceive; especially when to this you add, the application of a multitude of names to one individual.

But, were you to give me an illustration, I should, perhaps, have a more accurate idea of the force of your remark.

You cannot have a better illustration than the god Osiris, who was at once the sun, a bull, a hero, and a golden calf. While this hero, Noah, has at least ten names; for instance, Bacchus is one of his names; but we find there is at least one in India, one in Egypt, and one in Greece. The Indian Bacchus was the first and most ancient of all that bore that name. He was the first, that pressed the grape, and made wine. He lived in India, before it had any cities. He was, they say, twice born, and nourished in the thigh of Jupiter. Now all this agrees with Noah. He was the first man in the postdiluvian world, so that he lived early enough to be the most ancient Bacchus; and Noah, according to Moses, was the first that made wine. Noah lived in those parts as soon as he came out of the ark, earlier than there were any cities built in India: and as to the last circumstance of Bacchus being twice born, and brought forth out of the thigh of Jupiter, Diodorus gives us an unexpected light into the true meaning of this tradition, telling us, that Bacchus was said to be twice born, because, in Deucalion's flood, he was thought to have perished with the rest of the world, but God brought him again, as by a second nativity, into the sight of men; and they say mythologically, that he came out of the thigh of Jupiter *. In addition to this, there are other persons, who received the name of Bacchus, whose history will not accord with that of Noah. But want of attention to this fact has caused considerable difficulties.

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* Warburton's Legation of Moses.

Will you now tell me the story invented by the Greeks, respecting Taurus?

Taurus, they say, is the bull into which Jupiter metamorphosed himself, when he conveyed the princess Europa across the sea from Phœnicia to Europe. Now, when you recollect, that Jupiter is emblematical of the vivific principle which animates all nature, and is another word for the soul of the universe, and that his essential properties are air, and sky, we see, that, though the Greeks created an allegory, they left the Egyptian idea at the basis. When also we consider, that the Phœnicians were so highly distinguished for skill and enterprise in navigation, what can be more natural than the simple narrative contained in this envelope? Here is included the health, the activity, and the vigour, imparted by the cheering breeze, the cloudless sky, and the transparent atmosphere, which invigorates the dauntless navigator, and prompts him to quit the sheltering cot, to plunge into the ample waters of the Mediterranean, and at length to reach the European coast.

Was Taurus anciently a constellation of equal extent and splendour with what it is at present?

Arcturus, the Pleiades and the Hyades, though now parts of this one assemblage of stars, were formerly regarded as three distinct constellations.

Did the Gemini of the Egyptian sphere resemble that which is found on our celestial globe?

Not exactly; it represented Hercules, and Apollo, in a sitting position, with their feet touching, and their arms extended to embrace each other.

Had the Egyptians any particular reason for uniting Apollo, to Hercules?

Probably, they meant to intimate the increasing strength of the sun.

May I inquire, how this portion of the zodiac was marked by the Chaldeans?

The Persian designation of Two Kids, is certainly far more applicable to agriculture, than that of Apollo and Hercules, which was probably the original Chaldean denotation.

But as two youths are delineated on our globes, is it not probable that the Greeks derived this from the Egyptians?

Yes; but not without the invention of an ingenious fable to make it appear their own.

Of what fable do you speak?

The fable respecting Castor and Pollux, the affectionate and heroic twin brothers, who, having cleared the Archipelago of the numerous pirates that infested its shores, have ever since been considered divinities highly friendly to mariners.

Is it not said in the Grecian story, that they live and die alternately?

Yes: this allegory is founded on the astronomical fact, of the one star setting, when the other rises above the horizon.

Who occupied the place of the Cancer of our sphere?

Mercury Anubis, or the deified Egyptian Taut. He bore the head of the ibis.

But why was the human figure dropped?

Because the sun, when he arrives at this part of the heavens, begins to go retrograde, and to descend obliquely. Therefore, to the head of the ibis, they added the tail of a crab, an animal that walks backward, or obliquely.

What is the Grecian fable relative to Cancer?

Cancer, they say, is the sea crab, which Juno sent to bite Hercules by the foot, while he fought with the serpent Hydra. This enemy was despatched, and Juno, unable to succeed in her attempts to lessen the fame of Hercules, placed the Crab among the constellations.

Can you cast any light upon this allegory?

Juno is, you know, the wife of Jupiter; and, as Jupiter may be regarded as the air or atmosphere, Juno is perhaps a personification of the clouds, to which the atmosphere may be figuratively said to be united. Hercules was the son of Jupiter, and Alcmena. If we suppose the latter name to imply exercise, the birth of Hercules is easily explained; for we know pure air, and muscular exercise, produce strength, which being personified, and identified with the name of Hercules, performed all the exploits attributed to that hero.

Hence not only the destruction of the Crab, but even of the Hydra himself, is intelligible; the death of Cancer prettily depicts the necessity of surmounting little obstacles, if we would achieve great exploits; the destruction of the Hydra in the fens of Lerna, is a beautiful figurative description of manual labour draining a marshy country. But Cancer, having been sent by Juno, informs us, that, while manly strength had to contend with difficulties, small and great, an annoyance of no inconsiderable magnitude arose, not only from the copious showers, but from the pelting torrents, which descended from the clouds.

How much obliged to you I am for this explanation, my dear mamma! Shall we now proceed to Leo?

Yes. The Leo of the Egyptian zodiac was designated, as it is at this day on our own sphere, by the lordly savage of that species in his proper form, and in the attitude of rushing forward. Thus does this sign denote the heat, and violence, of the solar ray.

Do you think this constellation was of Chaldean origin?

They must, I conclude, have regarded with considerable interest the beautiful star Regulus; but, as the Lion is of more frequent occurrence, and the heat is more intense in Africa, than in Chaldea, its origin may with greater propriety be attributed to Egypt, than to Chaldea.

What do the Grecians say of Leo?

They say it is the celebrated Nemæan lion, which had long kept the inhabitants of Argolis in Peloponnesus, in the most dreadful state of alarm, whose skin was proof against all weapons; but which was at length killed by Hercules, who clothed himself with its almost impenetrable covering.

Whom did the Egyptians portray in the place of the Virgo of our sphere?

Isis: and she, having been the inventress of the art of cultivating grain, properly bears in her hands, three ears of ripe corn. In the Persian zodiac, she is the famed Urania, or Babylonian Venus; for, in every country and in most systems of mythology, the principal female divinity has been elevated to this portion of the zodiac. The Grecian narrative relates, that this is the virgin Astræa, the goddess of justice, who lived upon earth during the golden age, but, from the wickedness of man, left it, and took her residence among the constellations.

To what does this refer?

It is impossible to affix any definite idea to the golden age, of which the ancients speak, unless we direct our thoughts to the state of perfection and happiness, enjoyed by man in

Paradise. Since his expulsion from that sacred retreat, the varied page of history, presents but one scene, the very reverse of all they depict of the golden age.

Was Libra originally an Egyptian sign?

Yes: Libra was an utensil applied to the mensuration of the waters of the overflowing Nile, and, on the Egyptian zodiac, is engraven in the hand of the person, who had in charge the proper adjustment of the inundation. The human figure is erased from our sphere; but the Balance itself has descended an unaltered asterism, to posterity. Independently, however, of the Libra being one of their most celebrated hieroglyphics, there is another cogent reason for supposing this sign to have been originally of Egyptian invention.

The Chaldaic zodiac, Mr. Costard has informed us, consisted only of eleven signs, that part of the heavens being usurped by the vast claws of the Scorpion. The same argument may be advanced, in order to prove that the sphere of Egypt, was a secondary sphere.

What is recorded of this constellation in the mythology of the Grecians?

It informs us that the constellation of Libra, consists of the scales of Astræa. Hence it is called by Virgil, "Astræa's balance;" this goddess, when painted, being always accompanied by these scales, as an emblem of her character.

To what, or whom, did the Egyptians refer in the horrible-looking Scorpio?

There we see a symbol of the malignant Typhon, the enemy of Osiris, and the evil genius of Egypt.

But why was he placed in the heavens?

He was placed in this portion of the circle, to show that the power of Osiris, or the Sun, had declined in the heavens, that he had entered into the distant wintry signs, and therefore that his determined foe had gained a temporary ascendance, chilling the atmosphere, and checking vegetation. In fact, the greater part of the Egyptian zodiac, apparently alludes to the contests of these two mythologic personages for the empire of the skies.

Then the Greeks, I suppose, did not materially vary from this representation?

Their story shall be told you. Scorpio, they say, is the scorpion that stung to death the boasting hunter Orion; for he not only declared, that there was nothing on this terrestrial globe that he could not conquer, but he challenged Diana herself to the contest, which gave so much offence, that she sent the scorpion to gratify her revenge, which he successfully executed. Here is a riddle. Can you give me the explanation?

I am sure, if I were to try for ever, I should not find it out: but pray help me, by telling me whom they meant by Orion.

By Orion, Nimrod was referred to.

Whom did Diana denote?

The moon. Now can you proceed?

Perhaps I dimly discern the outline; but do you fill up the picture.

Since Nimrod, and Belus, who built the observatory at Babylon, are generally considered as the same person; we are not, Mr. Maurice observes, to wonder at finding the Orion of the Pagan world, the copy of the former, blending the science of astronomy, with the sports of the field. We may trace the resemblance in the close and curious attention of both, to Diana. In the boasting hunter, we discover the anxious astronomer of Chaldea, fixed in intense contemplation upon her orb, and watching her phænomena, to enable him accurately to mark the lunar revolution, and to form that first effort of astronomy, the lunar mansions. Her reluctance, and revenge, may shadow out the ill success of the first attempt, as his death by the sting of a scorpion doubtless does his decrease, when the sun was in that noxious sign.

Who is Sagittarius?

The armour-bearer of Osiris, in the form of a Centaur, darting his fiery arrows against that dreadful Scorpion delineated in the preceding asterism: that malignant and destructive Typhon, who, according to the Egyptian mythology, was engendered amidst the putrid slime and other filth left by the retiring waters of the Nile. "The mythologic birth of Typhon unfolds to us no inconsiderable portion of the whole allegorical history, and at the same time unveils the real source of the famous Grecian fable of Apollo, shooting with a thousand arrows the serpent Python. Under the signs Leo, and Virgo, the Delta of Egypt was inundated. During the sun's progress through the equinoctial sign Libra, the waters of the Nile were gradually subsiding, and the unwholesome damps, and pestilential vapours, that arose after so vast a body of waters was withdrawn, were denominated Typhon, and symbolically represented by Scorpio. These could alone be dissipated and rendered innoxious by the beams of the sun, the mighty archer, whose rays, like burning arrows, pierced through and annihilated the mud-generated monster. The Greeks, during their frequent migrations into Egypt, learned this ingenious allegory, and as ingeniously built upon it the story of Apollo and the serpent Python. By the transposition of a letter, Typhon was converted into Python, or possibly Python was the original Egyptian name, since Pethen, in the Hebrew language, signifies a serpent; and the fabulous birth of the Grecian Python was as really made to square in exact union with that of the Egyptian Typhon. According to Ovid, Python was a monstrous serpent, that sprang out of the slime of the deluge of Deucalion, upon whom Apollo, only another name for Osiris, in attempting to destroy him, exhausted nearly the whole contents of his quiver. That is, his rays penetrated through and through the collected clouds, which overshadowed the humid sphere, and prevented its receiving the benefit of his genial warmth. This important victory occasioned the name of Pythius to be given to the victorious Apollo: hence the priestess of the Delphic temple was called Pythia, and hence came to be instituted the Pythian games, which were intended to celebrate this victory over the dreadful serpent." Surely this is sufficient to evince, that the Greeks were sometimes servile copyists from the mythology of the Egyptians.

The figure of Capricornus is a curious compound, and by the rule you have given, I conclude, it is of Egyptian origin; for it is a strange hieroglyphic, consisting of the head of a goat, and the tail of a fish.

There is some propriety in your conjecture. This symbol is allusive at once to the course of the sun in the heavens, and emblematical of the rains and moisture, which prevail at the commencement of the autumnal season.

What is the reason the ancients designated this portion of the solar path by the figure of a goat?

Macrobius informs us, that this animal, in feeding on the springing herbage, delights to climb the mountains, and that the sun, in Capricorn, quits the lowest point of his course to regain the highest.

But what is to be understood of the fish's tail?

Undoubtedly, the solstitial rains, that fall at this period of the year; whence, in the mysteries of Mythras, the constellation was denominated the celestial floodgate.

Does this agree with the seasons in Egypt?

No; it does not. Hence it is evident, that this part of the asterism was imported from another country.

In the Egyptian zodiac I see Anubis, with the dog's head, leading on the zodiacal Goat; how am I to understand this?

I know no way but by supposing, that the dog Sirius, whose heliacal rising, announced the annual inundation of the Delta, was the usual symbol in Egypt, to express approaching rain, which M. Savary asserts does occasionally, although in very small quantities, fall in Lower Egypt.

What say the Grecians of this constellation?

They make it to be Pan or Bacchus, who, being obliged to fly from the giant, Typhon; for the purpose of obtaining shelter in the Nile, transformed himself into a sea-goat. Jupiter, delighted with the contrivance, made him a constellation.

What does the name Pan signify?

It is a Greek word, denoting "all things;" hence it is often used mythologically to signify the great principles of vegetation, and animal life. After what has been said, no farther illustration seems to be required.

Then I may inquire, how the Aquarius of their sphere is formed?

By a representation of Canopus, the marine god of Egypt.

How curiously this deity is symbolized by a vast urn, with human feet, and a human head! Did this sign originate in Egypt, or in another country?

Not in Egypt, because it bears no relation to the seasons of the year in that country. It is, however, very remarkable, that the contraction, ♒, which represents a flood in motion, is one of the hieroglyphics, most frequently to be met with on the ancient monuments of Egypt; a circumstance, which Mr. Bryant thinks, has reference to an object of far greater consequence, than the denotations of a particular season of the year, namely, to the general deluge.

But who is the Aquarius of the Grecian sphere?

Ganymede, who succeeded Hebe, as cupbearer to the gods, is generally imagined to have been constellated in this sign.

Who was Hebe?

A daughter of Jupiter and Juno.

Then what is here personified?

Very probably the dew, which proceeds from the air and clouds. The dew supplies the other powers of nature, which are personified, and deified, as fertility and vegetation, with refreshments, and may, therefore, be said to produce revivification.

We come now to Pisces, and I see, there is here a human, and a bestial form.

Yes; this is one of the many examples of the monstrous system, adopted by the Chaldeans, Egyptians, and Hindoos.

What person has been thus portrayed?

He, who is here exhibited, bears too exact a resemblance to the dragon of Chaldea, and to the Indian Veeshnu in the Matsya Avatar, to leave any doubt of the identity of the persons, as well as of the mythology. In fact, after displaying to us so striking an emblem of the deluge, in the preceding sign, they could scarcely avoid bringing before our sight, that illustrious personage, who first rose from the bosom of the subsiding waters, the great Oannes, or fish-god, who appeared twice to mankind, and, in a form half-man, and half-fish, instructed the Babylonians in letters and science.

The human part of the figure was in time dropt; and first one fish, and afterwards an hieroglyphic consisting of two fishes, connected by a cord, was adopted in the room of the ancient symbolical character.

What is the Grecian story of this constellation?

Venus, and her son Cupid, transformed themselves into these fishes, to avoid the fury of Typhon.

Pray explain this a little more fully.

Venus was worshipped by the Greeks as the goddess of pleasure, and was fabled to have been produced by the prolific power of Time, and likewise to have sprung from the froth of the sea. When formed, she was laid in a beautiful shell embellished with pearls, and wafted by gentle zephyrs to the island of Cyprus. At her landing, flowers rose beneath her feet. She was received and nursed by the Horæ, the goddesses of the four seasons, who braided her hair with golden fillets; and then conveyed her to heaven, where she appeared so lovely, that all the gods desired to marry her, but Vulcan alone was approved. She is sometimes represented clothed in a light purple robe, glittering with gems; with a magnificently ornamented zone, or girdle, called a Cestus, round her waist; roses decorate her head, while she is drawn in an ivory car by swans, doves, or sparrows. At other times, she stands attended by the Graces; but in all situations her son, Cupid, is her inseparable companion.

Will you tell me first, what I am to understand by Venus being formed by Time, and rising out of the sea?

It signifies, that after the creation of the earth, the sea, and the atmosphere, of the sun and the moon, which were considered as works of Time; Venus, or the beauty and harmony of the universe, was the result.

What did they mean, when they said she was attended by the Horæ?

It meant, that, whilst the sun, and stars, have an apparent annual motion round the earth, the hours, or four seasons of the year, agreed to complete the beauty, and harmony, of the universe.

What does the Cestus mean?

Probably the zodiacal constellations, and planetary bodies. For Venus was sometimes called Urania or Celestina; and in Sicyon, the most ancient kingdom in Greece, she was represented with a crown on her head, which terminated in a point, to intimate the polar star.

What by Cupid, or Love?

Perhaps the physical principle of attraction, which preserves the heavenly bodies in the places assigned them by their Creator.

What by her being worshipped in the island of Cyprus?

By this the Greeks would have us to understand, that the beauty and harmony of the universe were first perceived and admired in that island of the Mediterranean, and that her worship, having been translated thence to other islands in Greece, Venus was said to have travelled to them.

I do not wonder, that a goddess, so beautiful, had a place assigned her in heaven; but I do not understand, how it happened, that Vulcan obtained her as a wife.

The probability is, that this only signifies, that ingenuity was approved by, and closely allied to her.

As a conclusion to this conversation I will give you a table, containing the names of the constellations, the appellations of the eight principal deities of Egypt, symbolized in these constellations, the abbreviation of each asterism, the number of stars, the denotation of the principal stars in each constellation, and their magnitudes.

Names of Constellations.	The Deities of Egypt represented in the zodiacal Constellations.	The Abbreviation of each Asterism.	The Number of Stars.	The Names of the principal Stars, and their Magnitudes.
1. Aries, the Ram.	Jupiter Ammon.	The horns of the animal, ♈.	66	α Arietis, 2.
2. Taurus, the Bull.	Osiris by Apis.	The first abbreviation exhibited the head of the Bull entire; the present is formed solely of the outlines of that head, ♉.	141	Aldebaran, 1; Pleiades, Hyades.
3. Gemini, the Twins,	Hercules and Apollo.	An outline of the twin brothers embracing, ♊.	85	Castor and Pollux, 1. 2.
4. Cancer, the Crab.	Hermanubis or Mercury.	The head of the Ibis, added to the tail of the Crab, ♋.	83	Acubene, 4.
5. Leo, the Lion.	....	The hinder part of the Lion, ♌.	95	Regulus, 1. Deneb, 2.
6. Virgo, the Virgin.	Isis.	The three spikes which the Virgin has in her hand, but not very clearly delineated: ♍.	110	Spica Virginis, 1. Vendemiatrix, 2.
7. Libra, the Balance.	....	An inverted Balance, ♎.	51	
8. Scorpio, the Scorpion.	Typhon.	The envenomed barb of the Scorpion, ♏.	44	Antares, 1.
9. Sagittarius, the Archer.	....	The arrow which the Centaur bears, ♐.	69	
10. Capricornus, the Goat.	Pan.	The union of the horns of the quadruped, and the tail of the fish, ♑.	51	
11. Aquarius, the Water-bearer.	Canopus.	A flood in motion, ♒.	108	Scheat, 2.
12. Pisces, the Fishes.	....	The outline of fishes united by a string, ♓.	118	

CHAPTER XVI.

CONSTELLATIONS IN THE NORTHERN HEMISPHERE.

Of each of the twelve constellations, which never set in the latitude of London, I will give you a short account.

With which shall you begin, mamma? Shall it be that nearest the pole?

Yes: you can tell me the name of that assemblage of stars, and of the one at the extremity of the tail.

The name of the constellation is Ursa Minor, and the star to which you refer, is Alruccabah, or the polar star. By what people was this constellation formed?

Its name, Cynosura, would clearly give it a Grecian origin; but its more ancient name was Phœnice, which leads us to look to the Phœnicians, as its inventors. It is, therefore, probable, that Thales brought it thence into Greece. Indeed, without the influence of the guiding ray of the polar star, we can conceive it scarcely possible, they could have undertaken their daring expeditions.

How many stars are there in this group?

There are seven, which, in their arrangement, resemble those of the Great Bear; but the whole of this constellation comprises 24 stars.

What do the Greeks say of this constellation?

Diana's nymph, Callistho, and her son Arcas, were, they say, turned into bears, by the jealous and imperious Juno; but, to preserve them from injury, they were translated to the heavens.

Did this constellation ever exist in any other form than that of a bear?

Yes: both this and Ursa Major were formerly represented by the outline of a wagon.

Nor can it be doubted, that the stars approach nearer to that form, than to the animal referred to.

The four stars, placed in a quadrangular form, may to the eye of fancy represent the body of a carriage, while the other three, placed one before the other, may present the idea of three oxen, or horses, harnessed, and drawing the wagon round the polar star.

But how is it probable, that the appellation of wagon, should ever have been changed into that of Great Bear?

You are fully aware, that this is a very large constellation; so large, that when the star, Dubhe, comes to the meridian on the first day of every month, it is above the pole, while the southern extremity approaches within about thirty-two degrees of the equator, extending to the seventy-second degree of north declination. So that it is vertical, by the diurnal motion of the earth, to Europe, most of Asia, and to North America. You will not, therefore, be surprised, when I tell you, that the Indians called this the great constellation. So far I can proceed: for the rest, I must refer you to Mr. Maurice, who says, "the three words, the great constellation, are in the Sanscrit comprised in the term Maharesha. This the Greeks translated literally, the Great Bear; but it should be remembered, that the latter member of the Sanscrit word signifies at once a constellation, and a bear. From this compound Indian word, ill understood, it is more than probable, that on the present sphere that monstrous production, unknown in any region of the earth, a bear, with a very long tail, was portrayed. In similar mistakes may possibly have originated the other monsters, equally unknown to nature, and delineated on our sphere; as dragons with hairy heads, and crooked dolphins."

How many stars are there in this assemblage?

Eighty-seven.

Whom did the Greeks honour with a place in this constellation?

Callistho.

Will you tell me who Callistho was, and give *me the explanation of what you said respecting the Little Bear.*

Callistho was probably an ancient astronomer, who, from his almost incessant attention to Ursa Major, was denominated the son of that constellation; and, when he was dead, his soul was thought to have taken up its abode in Arcturus, the nearest star of distinguished splendour, whence it might continue to observe the object of its regard.

Which of the two Bears, was the constellation first formed?

The greater Bear. This for a time was the guide alike on the ocean, and through the deserts of Arabia; but, as commerce increased, this was found to occupy too wide a space in the heavens to be an unerring guide, when it is probable the brilliant and steady light of Alruccabah attracted the attention of astronomers: finding stars, that could be formed into a group resembling their admired guide, they added a new, a valuable constellation. From the situation of the polar star, this constellation was placed among the hieroglyphics of Egypt, as an emblem of stability.

You have given to the formation of Ursa Major and Minor, a very early date, attributing one, I presume, to Chaldea, and the other to Phœnicia; do you assign Draco to either of these countries?

No: the probability is, that all the figures on the sphere, composed as this is, in a mixed heterogeneous manner, of the parts of animals of opposite character, and genius, are to be considered of Egyptian origin.

To be sure, the head of Draco is a very curious one for a serpent; it resembles that of a bird rather than that of any other creature. How could the Egyptians make such an animal?

It arose from that hieroglyphic taste, for which they were so remarkable, by which they meant to shadow out the attributes of their gods, or the vices, virtues, and other distinguishing properties of men.

But, as the Greeks were so apt at accommodating every thing to their own mythology, I wonder they did not cut off a little of the hair about the serpent's neck, and make the figures altogether more elegant and correct.

We see, however, that the Greeks did not thus act; they retained the asterism, but invented for it a new fable.

I am now unavoidably led to inquire to what the Egyptians referred, in this odious constellation?

To nothing less than to the malignant reptile, by whose delusion mankind were plunged into ruin and misery; and such was the effect of the painful remembrance of this fact, that their detestation of the grand deluder, under the name of an evil principle, broke forth on every occasion, on which it could be signally displayed. Thus we find it, in the form of a dragon vomiting forth flames, there a serpent of stupendous length, and of horrible contortions. When the fatal influences shed by the polar dragon were imagined to be discovered, the name of the destroyer Typhon, was conferred upon it, and almost every nation of Asia, in conformity with the widely diffused principles of the prevailing physical theology, had its benevolent, and malignant star; its Osiris, and Typhon, its preserving Mithra, and its destructive Athriman. Even Lucifer, himself, is spoken of in Scripture, as "the star of the morning, but fallen from his glory."

I should very much like to know the new fable which the Greeks built on this foundation.

They invented the story of the immense dragon of the Hesperides, the vigilant animal that guarded the golden apples.

Will you favour me with the narrative?

The Hesperides were three celebrated nymphs, the daughters of Hesperus *, who were appointed to guard the golden apples, which Juno is said to have given Jupiter, on the day of their nuptials; and the place of their residence, is stated by Hesiod, to have been beyond the ocean, or rather the pillars of Hercules, now called the Straits of Gibraltar. These islands are also said to have been situated near Mount Atlas in Africa. This celebrated place abounded with fruits of the most delicious kind, and was carefully guarded by a dreadful dragon, which never slept; but Hercules, by the assistance of Atlas, killed the dragon, and procured the fruit.

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* Memorandum XII.

I am sure, the Greeks have so managed it, that I should not know the story again.

You will remember it was the express object of this ingenious people, so to vary the narrative, that, having borrowed an idea, they might present it as their own. Besides which, another train of thought might be in their minds, and by the union of the two, they produced the result I have just given you.

Will you explain to me a little more fully what you mean?

Yes. It is probable that the fable might be founded on some transaction of notoriety, or upon some interesting features in nature, observable at the moment it was registered; still, its author could not be ignorant of the tradition of man's disobedience, of the beauties of the garden of Eden, and of its forbidden fruit; yet, from the account I have given you of the Hesperides, it is probable the Canary Islands were not forgotten, which, even at this moment, are famous for exquisite fruits. These islands could possibly be seen from the summit of Mount Atlas, where Hercules went to ascertain their distance from the continent; Atlas was, therefore, said to assist him in his hazardous enterprise.

Again, we know that such was the barrier, God opposed to an approach to the tree in Paradise, that death was the immediate consequence. The Greeks say, that the golden fruit in the garden of Hesperides, was guarded by a watchful dragon, but not so deadly were the consequences of its sting, as were the effects of Adam's disobedience. While their allegory might embody this idea, nothing could be a more beautiful figure, than a dragon that never slept, of the restless and turbulent ocean by which the Canary Islands were surrounded. Hercules is represented as conquering the dragon: on the one side this may intimate Adam taking the fruit, in contempt of the opposing injunction; on the other, that strength and perseverance, overcame the dangers of the passage, obtained the fruit, and returned to Greece.

Some of the Greek mythologists have related another fable relative to the celestial Draco, which probably is also a perversion of a part of the primitive tradition. They affirm, that in the war of the Titans, that is, of the good and evil demons, contending for the sovereignty of our globe; this mighty dragon was introduced into the line of battle, and opposed to

Minerva, who not only repelled his assault, but hurled him from the heavens, and fixed him to the axis of the world.

But you told me in a former conversation, that great veneration was anciently paid to serpents, and that they were looked upon with reverence, as being endowed with superior wisdom.

That is true: still there is no doubt that the dragon and serpents, for they denote the same object, were at first regarded with dread, and detestation, and the fear of the baneful effects, which resulted from their influence, led a timid people to prostrate themselves before altars erected, to pacify the evil demon. In succeeding periods, its annual renewal of its skin, added to the great age to which it sometimes arrived, and to its forming a circle, which has no termination, when its tail comes in contact with its head, induced the primitive race to make it the symbol of immortality. Serpents, biting their tails, or interwoven in rings, were thenceforward the favourite symbols of vast astronomical cycles of the zodiac, and sometimes of eternity itself. The Mosaic tradition concerning its being more subtle than any other animal, led to its being considered the emblem of wisdom. Such are some of the circumstances, which exalted the serpent to the rank of a good demon. Dr. Long informs us, that 2800 years before Christ, the star α of Draco was in the solstitial colure:

he adds, that it must have been about ten minutes from the pole, and that it might have been thought the pole star, and fixed immoveably in the heavens. The Chinese shepherds and mariners, therefore, blessed its friendly light.

How many stars are there in the constellation Draco?

Eighty.

I think, mamma, the little constellation Tarandas, is situated near the north pole?

Yes: it extends from the north pole nearly to the Arctic circle. It has lately been introduced.

How many stars does it contain?

Only a few, and they are very small; one in the left branch of the horn, is of the fourth magnitude, and this is the largest in the constellation.

Is not Camelopardalis also a new constellation?

Yes: it was formed by Hevelius.

But is there to be found a creature as curious as the one here portrayed, with a neck of unusual extent, and with long legs before, and short ones behind?

Such a quadruped exists, in the interior of Africa, and the animal is of a docile disposition, somewhat resembling a camel in shape, but taller; its skin is finely variegated like that of a leopard, and its horns and hoofs are prepared, and used in medicine. Linnæus makes it a species of the stag kind.

How many stars does it contain?

Fifty-eight; and, though the most conspicuous one is of the fourth magnitude, yet this constellation may be distinguished, by your remembering, that it extends from Auriga to the north pole, and that the most conspicuous star is situated nearly on the Arctic circle.

What a curious constellation is that you have just mentioned! it represents a man in a kneeling posture, with a goat and kids on his left shoulder. Who is Auriga?

The Greeks differ very materially in their account of him, though they agree in attributing to him some merit in the invention of chariots, in the management of horses, and in the manner of harnessing them to these vehicles. It is probable, from this account, that Auriga is the noted Phaeton, the son of Sol, who, elated with his past success, entreated his father's permission to guide his chariot for one day; but, setting the world on fire, was struck by Jupiter into the river Po.

What does this allegory imply, mamma?

There appears to be reason for thinking that it alludes to an immensely large comet, of which Aristotle speaks. It was, he informs us, seen in Achaia, at the time Aristarchus was Archon. "It was," he says, "very near the sun, its light extended like a forest, as far as to the third part of heaven, and it ascended to the belt of Orion, and was there dissolved." So that the light diffused itself over the part of the heavens, now called Auriga; and probably in memory of this astonishing comet, which was supposed to have occasioned an earthquake, great dryness in the atmosphere, and an inundation of the sea, which occurred while it was visible, this group of stars was assembled into a constellation.

What did they mean by saying it went into the river Po?

As the comet proceeded in its orbit, to casual observers it seemed to be lost, when it reached that part of the heavens, where Orion is situated; but by more accurate inspectors of the heavens, it was seen to fade from sight in the adjoining constellation, Eridanus, or the river Po, where, poetically speaking, it was drowned.

How many stars are there in Auriga?

Sixty-six. The most beautiful is Capella, situated in the left shoulder.

Does not the right foot of Perseus almost touch Auriga?

Yes. We should be ready to give Perseus a Grecian origin, did we not find the same collection of stars distinguished by the Hindoos, and from them receiving the name of Parasica, which, together with other circumstances of similarity, renders it probable that both the Hindoos and Greeks received it from an older nation.

There is something so terrific in the aspect of the head, which he has in his hand, that I long to hear his history.

The poets say, that he was the son of Jupiter and Danae. At his birth Mercury gave him a cimiter, and wings for his heels; Pluto, an helmet which rendered him invisible; and Pallas furnished him with a shield, which reflected objects like a mirror. Thus equipped, he departed on an expedition to destroy the Gorgons: the heads of these monsters were covered with snakes, and their countenances were so horrible as to change persons, who saw them, into stones. Perseus, however, rendered himself invisible to them by means of his helmet, saw the image of Medusa, the eldest of them, in his shield, and aiming his blow accordingly, cut off her head with his cimiter.

I am sure, I should be a long time unravelling this enigma; pray help me, mamma.

Indeed, I apprehend you would: mythologists have, in all ages, had more trouble in discovering its import, than that of any other Grecian fable.

Now I hear that, I must leave all the task to you; pray begin by telling me, what is meant by Medusa's head turning people to stones.

By this, it is probable, we should understand, that Medusa's head resembled a stone. Now, the human head is in form much like an egg; Medusa's head, then, we will venture to call an egg. Jupiter, or the atmosphere, assisted by Danae, the mother of the egg, produced Perseus, or animation, which broke the shell.

Pray what was the result of this grand affair of breaking the shell?

Something more than you would expect. Perseus, you are prepared to see, escapes from the imprisonment, but perhaps not to behold Pegasus, a winged animal, also take his flight from the shell.

This is strange, indeed! how do they account for it, mamma?

They say it was produced by the blood of Medusa, or from a part of the inside of the egg. The wings of this animal afterwards furnished mankind with pens, which, when dipped in the fountain of the Muses, transported their ideas, as rapidly as Pegasus could fly, to distant parts of the world.

I suppose all you wish me to believe respecting this is, that it is the Grecian fable allusive to the invention of the art of writing?

Exactly so; and as Pegasus, the winged horse, is said to have been a favourite of the

Muses, so the pen is the favourite instrument with all literary characters.

On the globe I see Medusa's head, disfigured with snakes in the place of hair.

That rather tends to confirm the illustration here given; for serpents are oviparous, or produced from eggs, as well as birds.

But you have not been speaking to me about a bird.

No: but about a strange animal, which you must consider of more importance than a bird; for to the swiftness, and to the utility of the winged tribe, are added the strength and stability of the horse.

You told me just now, that Perseus destroyed the Gorgons, the three monsters, whose heads were covered with snakes. How shall I understand this?

You may without impropriety admit, that as civilization, and the energy which associated intellect inspires, advance, noxious animals, with their associates, dread and superstition, are banished.

Ah! I understand now; for you told me that Perseus is animation; and that Mercury, Pluto, and Pallas, lent their aid for the perfection of his person.

But it does not appear to me improbable, that, in addition to the noxious animals, with which an uncultivated country abounds, there may, under the figure of three monsters, whose heads are covered with snakes, be an allusion to the vicious habits of mankind, which degrade the intellectual being into a reptile, which transform the tender heart, into a heart of stone. An animation, great as the expanded wings of Pegasus and the courage of Perseus would intimate, pure as the white colour of the horse would suggest, and heavenly as his exalted station on celestial ground would imply, are necessary to elevate the degraded mind of man, and to eradicate his vicious propensities.

There is a very curious fact I have heard about the Gorgons.—It is said, that they had but one eye, and one tooth, among them; that they used it alternately, and that it was while in the act of transferring the eye, the one from the other, that Perseus cut off Medusa's head.

This part of the story is as instructive as it is curious. It most certainly intimates the confined and limited resources of ignorance and vice; and brings to our view the important fact, that to an enlightened and susceptible mind, there is around the dictates of philosophy, around the precepts of morality, around every thing that bears the stamp of truth, an irradiation of light, superior to the glimmerings of ignorance and falsehood.

How many stars are there in Perseus with the Caput Medusæ?

Fifty-nine.—You will recollect, I once mentioned to you the changeable character of the star Algol, situated in Medusa's Head; it varies continually from the second to the fourth magnitude, and the time taken up from its greatest to its least degree of lustre, is nearly three days.

I see, mamma, that the raised arm of Perseus almost touches Cassiopeia. Who is she?

She is intimately connected with two constellations at no great distance from her; for she is the wife of Cepheus, and the mother of Andromeda.

Then, I suppose, I ought to inquire, who was Cepheus?

He was a king of Ethiopia, and one of the Argonauts. He is represented in the habit of an eastern monarch, with a sceptre in his right hand, and extending the other, in allusion to his power. This constellation, you see, extends nearly from the pole to the galaxy.

How many stars are there in this constellation?

Thirty-five: and it is an interesting fact, that under the names of Capeny, Casyapa, and Antarmada, these three constellations, Cepheus, Cassiopeia, and Andromeda, are well known by the Hindoos.

How many stars are there in Cassiopeia?

Fifty-five. You observe her situation.

It is, I see, in the milky way, with her feet *touching the Arctic circle. But still more completely across this path "powdered with stars," Cygnus the Swan appears. I suppose, under this elegant form, in this delightful situation, I shall find more than an ordinary king and queen.*

Your conjecture is right: this stately bird commemorates some of the exploits of Jupiter.

How many stars are there in this constellation?

Eighty-one.

Who introduced that curious little creature, which lies in the centre of the large constellations Cygnus, Cepheus, Cassiopeia, Andromeda, and Pegasus?

It was introduced by Hevelius, to take in sixteen small stars, which needed to be designated by some intelligible appellation.

What is its name?

Lacerta, the Lizard. There remains now but one constellation in the northern hemisphere to be mentioned, which does not set in the latitude of London. This is Lynx, situated between Ursa Major, and Auriga.

By whom was it formed?

Also by Hevelius. The animal, here portrayed, is usually called an ounce, and is of the cat kind. It is found in Germany, and Italy, in many parts of Asia, and North America, and is valuable for its fur.

How many stars does it contain?

Forty-four.

And pray, mamma, who was Hevelius?

He was a celebrated astronomer, born at Dantzick, who formed a catalogue of fixed stars, which he dedicated to the king of Poland. On looking on the globe again, I find, there is one small constellation of which we have not spoken. It is Cor Caroli, consisting only of three stars.

Who formed them into a constellation?

Sir Charles Scarborough, physician to King Charles II. in honour of that monarch's father. I will now give you a list of the constellations which I have mentioned, and with this we will close the present conversation.

Constellations.	Number of Stars.	Names of the principal Stars, and their Magnitudes.
1. Ursa Minor. The Little Bear.	24	Pole Star, 2.
2. Ursa Major. The Great Bear.	87	Dubhe, 1. Alioth, 2. Benetnach, 2.
3. Draco. The Dragon.	80	Rastaben, 2.
4. Tarandus.	6	
5. Camelopardalis. The Camelopard.	58	
6. Auriga. The Charioteer or Wagoner.	66	Capella, 1.
7. Perseus, Caput Medusæ. Head of Medusa.	59	Algenib, 2. Algol, 2.
8. Cassiopeia.	55	Schedar, 8.
9. Cepheus.	35	Alderamin, 3.
10. Cygnus. The Swan.	81	Deneb Adige, 1.
11. Lacerta. The Lizard.	16	
12. Lynx. The Lynx.	44	
13. Cor Caroli. Charles's Heart.	3	

CHAPTER XVII.

THE CONSTELLATIONS NOT YET MENTIONED IN THE NORTHERN HEMISPHERE.

If you will find Mons Mænalus, we will proceed regularly round the sphere.

Well, mamma, you have not chosen a very large constellation to begin with, and I can scarcely see any stars in it.

There are, however, eleven stars to be seen.

From what distinguished individual have these stars derived their name?

From Mænalus, son of Lycaon, a king of Arcadia. The same name is also appropriated to a mountain of Arcadia in the Peloponnesus, in Greece, sacred to the god Pan. Since you are dissatisfied with the size of this constellation, we will proceed to one of more consequence; but you recollect the restriction, that you proceed regularly.

Here then is the Serpent.

A constellation of commanding importance. In addition to the observations, that I made, when speaking of Draco, and in some degree to confirm those observations, I will give you the words of Maurice. "Serpents," he says, "have ever been divided into two distinct classes according to their qualities, the noxious and the innoxious. They have been immemorially considered throughout all Asia as sacred animals, and as having something prophetical in their nature. Their bodies have been selected as the usual and favoured abode of the Deity, and all the statues of Indian deities in the Elephanta caverns, are, therefore, enveloped with serpents, to mark their divinity." Having made these remarks, he adds, "The Indians, who universally believe in the agency of good and evil spirits, by no means conceive any thing absurd in the supposition, that one of the numerous and subtile spirits, that tenant the vast regions of the ethereal kingdom, should, by the permission of the supreme Governor of the universe, for wise, but to man inscrutable reasons, have entered into the beautiful and resplendent form of that peculiar serpent of eastern and southern climes, whose body glitters like flames, and, instead of crawling upon the ground like the common reptile of that name, mounts upon wings of burnished gold, like the flying serpent mentioned in Isaiah, the 14th chapter and 29th verse; and might, therefore, well be conceived to have been an angel of light by Eve; and it is more than probable, that the very general belief in this part of Asia, that brute animals in the most distant æras of the world, were not only gifted with speech, but also possessed the faculty of discoursing rationally, originated in some mutilated tradition concerning the serpent's accosting Eve on this fatal occasion in the human account."

And are you anxious, that I should believe this peculiarity in the Mosaic narrative?

Yes, indeed I am; for there is no medium; the whole is allegory, or the whole is literal. What must not be the importance of that point, upon which we can place our finger, and say, If this be fable, the whole fabric of our natural religion, the whole religion of the Bible, is false? For, if the record of Moses be not all simplicity and purity, the contents of the Bible itself are but the corruption of astronomical truth. But, while the whole mass of misery we see in the world, evinces, that man is a fallen, ruined, degraded creature, the peculiar degradation to which one half of the human species has been subject, appears to be the punishment entailed on them, because Eve was the first, and the more prominent person in the transgression: and any observations that intimate inferiority of intellect before the successful temptation, are certainly inconsistent with the Mosaic record. What a dignified answer she gives to the first inquiry proposed to her by the serpent*! and what do we afterwards read; but that, "when she saw the tree was to be desired to make one wise, she took of the fruit." Her intellect was, previously to this event, clear, and pure, and heavenly; now, indeed, it is debased, but is not this the result of her subjugation, and does not this flow from the malediction pronounced on her*? Yes: the sentence is executed in all its force, till the Restorer to a better paradise appears. Where He is known, or, in those countries where only the semblance of His blessed communications is observed, females are restored to their original station. Whenever the idea that the Mosaic record is a fable, strikes the mind, this fact should be remembered.

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* Gen. iii. 2, 3.

But, mamma, is it not difficult, and almost impossible, to separate Serpens and Serpentarius? See how they are entwined together.

Nor would you wish, my dear, to separate the antidote, from the malady; the physician from the disease.

Certainly not; but how do these remarks apply to the union of these two characters?

It is very satisfactory to know, that in the Persian, and it is scarcely less so to see in the Grecian, system of astronomical theology, that to the hands of Serpentarius himself they have elevated their evil genius.

Who then is Serpentarius?

He is a personification of the good principle; and the union appears to be founded upon some tradition respecting Him, who should bind, and mitigate, and finally destroy the power of Satan;

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* Gen. iii. 16.

for, in this delineation, the inventors doubtless followed the popular and established opinion. When, in addition to this, I see the foot of this illustrious personage, planted firmly on the back of Scorpio, my mind is irresistibly led to Him, who hath spoiled principalities and powers, to Him of whom it was of old declared, that his enemies should become his footstool.

Will you have the goodness to tell me, under what fable the Greeks have shrouded these truths?

Serpentarius, they say, is Esculapius, the god of physic, whose skill was so great, that Pluto complained to Jupiter, that he depopulated the infernal regions. By the Grecians, this was a beautiful metaphorical compliment to some eminent practitioner in the art of medicine; but, as it descended to them from some ancient nation, it appears allusive to that Physician by whom all the nations of the earth were to be blessed.

Why did the Greeks place the Serpent in the hands of Serpentarius?

As an emblem of the remedies employed by Esculapius; for some of the serpent tribe were formerly much used in medicine.

Here then the analogy varies.

I would rather say, here it exists under another form; for, it is remarkable, that, among the few symbolical references in our noble system of theology, the serpent is at once the emblem of the malignant destroyer, and of the beneficent Restorer of mankind; for, while, on the one hand, we hear the apology, "The serpent beguiled me, and I did eat;" on the other hand, we read, that, "as Moses lifted up the serpent in the wilderness (in allusion to his healing properties), even so must the Son of Man be lifted up;" destroying Satan in the very form in which *he* first acted the destroyer.

How many stars are there in these constellations?

In Serpens 64; in Serpentarius 74.

Hercules is, I think, mamma, the next constellation which I ought to select; for, in a most curious way, are the heads of Serpentarius and Hercules united.

Surely it could not be without design, the union was effected; but, why should that which is one and the same, though under different appellations, be put asunder? for when, among the fabulous stories of Hercules, we are informed, that he slew the monstrous dragon in the fens of Lerna, and when we find on the globe his foot placed as in the act of crushing its head; can we refrain from the assured conviction that the story of Hercules is founded on some tradition respecting Him, who should bruise the serpent's head; and that heathen nations had imbibed the idea thus boldly expressed by the king of Israel, "Thou shalt tread upon the lion and adder, the young lion and the dragon shalt thou trample under foot." The three-headed serpent he has in his hand, entwined with the branch of a fruit-tree, should not be overlooked. The lion's skin with which he is clad, and the club of strength, are worthy of notice.

With what new ideas I shall for the future look upon this celestial sphere!

I hope, you will; for recollect, I am only allowing you to sip a few drops from an overflowing fountain. These facts, thus sparingly imparted, are but one link in the long chain of your progressive improvement. When you shall read the works of able mythologists for yourself, you will find a most astonishing resemblance between Hercules, and Creeshna, between Creeshna, and our Lord Jesus Christ. For your present inspection I will make you three very small drawings in memorial of the information I have given you to-day. The first shall represent Serpentarius standing upon Scorpio, as his footstool: the second, Hercules with his foot prepared to crush the head of Draco: and the third, the Indian Creeshna, encircled with the same grand deceiver, the evil principle, the old serpent, the Devil. With regard to the differences you will find, in the

HERCULES.

C. T. Whitwell del.

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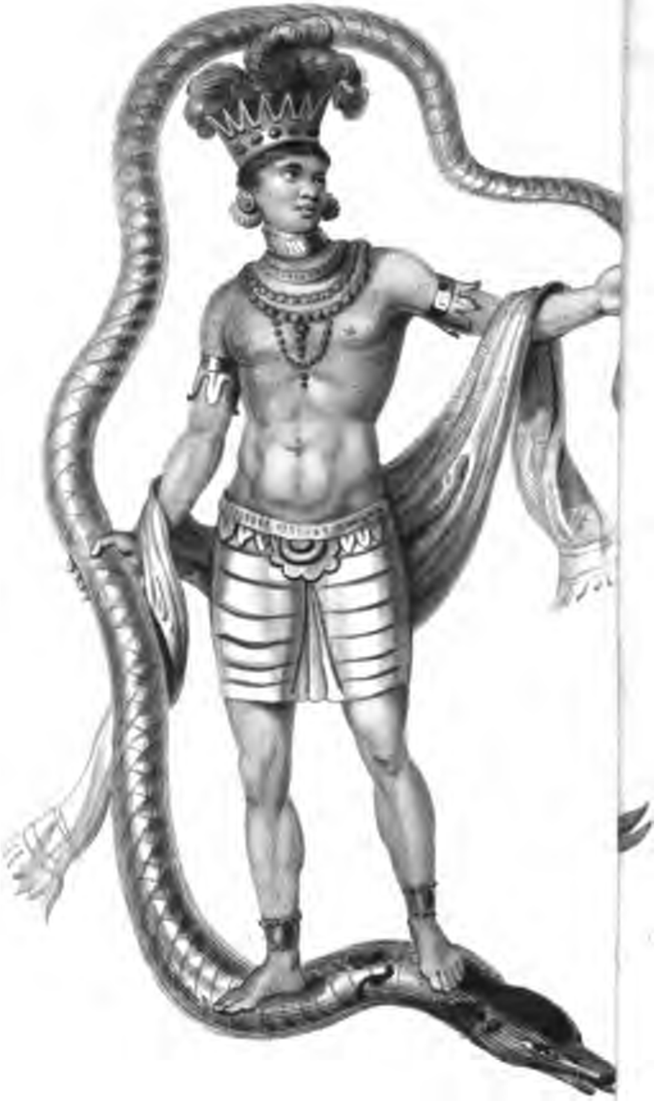
CREESHNA.



delineations of the lives of Hercules, of Creeshna, and of Him who became "incarnate for us," they are, upon the whole, satisfactory, since they evince, that it is necessary that, that divine revelation, which commences the communication, should continue the same, and should itself close the mighty mystery. In confirmation of which we see, that, in proportion as nations become more and more separated by time or place, from this source of light, though they may rise resplendent in all the arts and sciences, yet every thing respecting their mythology is increasingly obscure, so that its original features can scarcely be traced in the devotion of their people. Types, separated from their original intention, have given rise to the most absurd fables, and the most senseless idolatry.

You have not told me, mamma, by what nation this constellation was invented.

Probably by the Phœnicians; for the Phœnician Hercules is acknowledged to have been the most ancient of those, who bore the name. They seem, like every other nation of antiquity, to have deified their greatest hero, both in the sun, and in a constellation.

Who was their greatest hero?

Nimrod: and we observe, that "the ancient Pagan account of the æra in which Tyre was founded, and when the temple of Hercules in that city was erected, accord in a remarkable manner with the Scripture chronology of Nimrod or Belus, which fixes his greatest celebrity, as an Asiatic monarch, to about the year of the world 1800: for Herodotus affirms, that Tyre was founded 2300 years before the age, in which he himself flourished, or nearly five centuries before the Christian æra. At that period, the vernal equinox was in the first degree of Leo, whence their greatest hero Hercules, or, in other words, the sun in his greatest strength, was then said to be subduing the furious Nemæan lion, as he afterwards did the Lernian Hydra, the Hydra of the sphere, by the superior lustre and potency of the solar light, extinguishing that of the stars of the Hydra, which set or became occult when the sun rose."

What do the Grecians say about Hercules?

They describe him as the greatest hero of antiquity, and by introducing 113 stars into the constellation, render the number more considerable in this than is to be found in any other constellation in this hemisphere. I have already told you, that Hercules was the son of Jupiter and Alcmena, or that strength is the natural result of pure air, and muscular exercise. The twelve labours of Hercules may, without impropriety, be reserved, till you shall read them in larger works.

You will, then, perhaps, proceed to another *constellation. Near to Hercules stands a little Bull; I should like to know something about him.*

O, that is Taurus Poniatowski, so named in honour of Count Poniatowsky, a brave Polish officer, who saved the life of Charles the XIIth, king of Sweden, at the battle of Pultowa, near the river Dnieper, and also in the isle of Rugen, in the Baltic, near Stralsund. It contains only 7 stars.

Here is another little assemblage, distinguished by the name of Scutum Sobieski; what does that mean, mamma?

The shield of that heroic sovereign. It received its name from Hevelius, in commemoration of the valour of John Sobieski, who raised the siege of Vienna, when it was invested by the Turks in 1683. The Emperor Leopold, being driven from his capital, owed his preservation solely to this great monarch. Like the last, it contains 7 stars.

Not far from Sobieski's Shield, I see Aquila and Antinous; pray who are they?

Aquila symbolizes a king of the island of Cos, who married Clymene, one of the Oceanides. The circumstances related of this island, and his wife having been a goddess, certainly rendered it proper, that Merops should be placed among the constellations.

What is related of the island?

That it was the birthplace of persons of the greatest eminence, and that it abounded in excellent wines, and in silks and cottons of the most exquisite texture. The account which we have of the women of the island, allies them nearly to angelic beings.

That, indeed, was not wonderful, since their queen was a goddess. Will you tell me, who were the Oceanides?

They were sea-nymphs, and three thousand in number. Prayers were offered to them, and they were entreated to protect sailors from storms and dangerous tempests. The Argonauts, before they proceeded on their expedition, made an oblation of flour, honey, and oil, on the sea-shore, to all the deities of the sea, and sacrificed bulls to them, praying their protection.

Where is the island of Cos situated?

Near the coast of Asia Minor, about 15 miles from Halicarnassus.

Who was Antinous?

A youth of Bithynia, in Asia Minor, a great favourite of the Emperor Adrian, who erected a temple to his memory, and placed him among the constellations. Antinous et Aquila are depicted together on the globe, and are generally considered, one assemblage of stars.

How many are there in this compound constellation?

Seventy-four.

What a curious-looking creature that is, *which touches the wing of Aquila! is there a fish in the world like it?*

That constellation is Delphinus; and certainly no dolphin resembles it; for that is a beautiful object, and nearly straight.

Then how do you account for our having such an ugly creature on the globe?

"In Sanscreet, the word Sisumara, which is said properly to mean, a sea-hog, is also applied to a fish of the dolphin kind;" so that it is probable, that this outline is intended to be as much a representation of the former, as of the latter.

But why was either the sea-hog or the dolphin exalted to the sphere?

All that I can say in answer to this inquiry, will be, to explain to you the fable respecting it.

First, you will tell me the story, mamma?

The story is thus: an old man, named Neptune, wanted to marry a young woman, called Amphitrite, but she positively refused all intercourse with him. In proportion, however, to her obstinacy, his determination to bring about the union augmented. Being debarred of all access to her, he at length sent communications to her, by means of a dolphin, which were so fascinating, that at length the desired union took place.

This is a very pretty story. Now will you explain it?

You know Neptune is a symbol of the ocean; Amphitrite, of rivers; and Delphinus, of a fish.

The marriage of Neptune, and Amphitrite, may probably imply the union of the ocean with the rivers. The reluctance on the part of Amphitrite, may inform us of the difficulty there existed, in discovering the rise of some river, rendered interesting by its situation.

The connexion at length effected by Delphinus, may instruct us, that attentive observers, regarding every thing that might throw light on the subject, remarked that a certain species of fish, seen at one season of the year in this river, was at another discovered in the sea; the observer might in consequence place some mark upon a fish, which should more certainly inform him that the river, as he suspected, was not unconnected, but, after a thousand meanderings, by the side of precipices, and under mountains, at length emptied itself into some important sea, and was united with its parent ocean.

This idea appears as well founded as one of the arguments adduced in support of a free and uninterrupted communication between the Atlantic and Pacific Oceans round the northern coast of North America. The writer of a very interesting paper in the Quarterly Review for October 1817 *, says, that whales, struck with harpoons on the coast of Spitzbergen, are some-

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* Page 213.

times killed in the Straits of Davis, with the harpoons received in the former situation still in their bodies, and vice versâ. Captain Frank, in 1805, struck a whale in Davis's Strait, which was killed near Spitzbergen by his son, who found his father's name on a harpoon sticking in its body; and in the same year, in the same place, Captain Sadler killed a whale with the harpoon of an Esquimaux in it. The distance, which these wounded whales would have to run round the north of Greenland, is so much shorter, and whales are so rarely seen to enter the Strait of Davis round Cape Farewell, that the probability is altogether in favour of a direct northern communication between Spitzbergen, and the Strait of Davis; and, adds Lieut. Chappell, "the grounds for the existence of a passage from the Atlantic, to the Pacific, are similar." While the unity of the Grecian fable is preserved by the information, that Neptune placed Delphinus among the constellations, as a tribute of gratitude for its services; it also in some degree confirms the opinion which has been offered.

How many stars are there in this constellation?

Eighteen.

Between Delphinus and Cygnus I see three very small constellations; the Fox, the Goose, and the Arrow.

Vulpecula et Anser form one constellation, which was made by Hevelius out of the unformed stars of the ancients. It contains 37 stars. You can describe to me its situation.

It is, I see, on the tropic of Cancer, and lies across a branch of the Via Lactea. Is the Arrow then a more ancient constellation?

Yes; the Greeks say that Sagitta is one of the arrows of Hercules, with which he killed the vulture, that tormented Prometheus, who was tied to a rock on Mount Caucasus, by order of Jupiter.

Who was Prometheus, mamma?

I will tell you his story; and you will, I think, find out, upon what more ancient tradition the Greeks founded their narrative.

I shall be all attention, that I may resolve the enigma.

Well, then, Prometheus was a man of consummate skill. He excelled in the art of modelling so considerably, that he formed a most perfect female figure out of a lump of clay. All the gods were willing to add to the perfection of this workmanship, provided he could but impart life to it. He was so much elated by their promises, that he stole fire from heaven to animate the lifeless clay. Immediately Venus gave her beauty, Pallas wisdom, Juno riches, Apollo a musical voice, and Mercury eloquence. But Jupiter, displeased with Prometheus for stealing fire from heaven, gave the object of universal idolatry the name of "Pandora," or all gifts, and accompanied it with a box, inclosing every kind of malady that can afflict mankind. This, Jupiter well knew, would be opened, so that her punishment would be abundant; but, in addition to this, he doomed Prometheus to be chained to a rock for thirty thousand years, to have a vulture continually preying upon his liver, which grew as much by night, as it was destroyed during the day. They add, that all this really took place; but, at length, Hercules killed the bird of prey, and relieved Prometheus from his misery. Now can you tell me upon what facts, this beautiful allegory is founded?

I have some idea, that the opening of Pandora's box has an allusion to the effects of Eve's taking the forbidden fruit; but I must look to you for the solution of the rest.

It evidently relates to the creation of Eve as recorded by Moses; to the fatal act of disobedience by our first parents, to their expulsion from Paradise, and to the train of miseries which were the result. Prometheus appears to be Adam, and Pandora Eve; while the release by Hercules alludes to the coming of the Messiah, the great deliverer, from sin, and misery. So that to this little arrow you will henceforth see a chain attached, whose topmost link hangs suspended from the throne of God itself.

How many stars are there in this constellation?

Eighteen.

Nearer to the pole than Vulpecula, I see Lyra: whose harp was that, mamma?

The harp of the famous Orpheus, a Grecian poet and musician, one who resembles much the Apollo of India. When their contemporaries would express to us their skill in music, they say, the most rapid rivers stood motionless, the beasts of the forest forgot their wildness, and even the mountains, and lofty cedars, bowed their heads, to listen to the undulations of the air produced by them. Jubal, the father of all who handled the harp and organ, might at first be here symbolized.

The effect of music having been so great, it does not then appear wonderful, that the Lyre was placed among the constellations.

Originally the strings of the lyre were fixed to the shell of a tortoise, probably to denote their power over the finny tribe; but this has been dropped, and now the Harp is supported by a Vulture.

I hope, the number of stars in Lyra, bear some proportion to the melody of the instrument, under which they are constellated.

They are 22 in number.

I think, the constellation, which I had better next select, is Equulus, or the Little Horse.

Respecting this constellation, Mr. Maurice makes the following remark: "This is the horse's head of the Indian lunar zodiac, and though not much noticed in modern astronomy, makes one of the forty-eight old constellations, and was considered by the ancients as a very important one. The figure portrayed is that of the head, and part of the neck, of a horse, and is placed just before the head of Pegasus. Affixed as it were to that head, it exhibits the appearance of another horse urging forward by the side of him, and just getting the start of Pegasus by the head and neck."

There are in this constellation ten stars.

It appears I have now arrived at Pegasus, which you have already told me sprang from Medusa's head: in his fable I can trace out the invention of writing, and in him I see the favourite of the Muses. Will you tell me, mamma, why he received the name of Pegasus?

Because he was born near the sources of the ocean.

Did he there continue?

No; he fixed his residence on Mount Helicon, where, by striking the earth with his foot, he instantly raised a fountain, which has been called Hippocrene. And as you are by this time pretty well prepared for the marvellous, I may tell you, that others record, he left the earth, and flew up to heaven. He, however, was given to Bellerophon, to conquer the Chimæra. Mounted upon Pegasus, Bellerophon succeeded. But, though the end for which this great favour was bestowed, was completely answered, Bellerophon was so unwilling to let Pegasus go, that he attempted to fly with him to heaven. This act of temerity so incensed Jupiter, that he sent an insect to torment Pegasus, which occasioned the melancholy fall of the rider, who afterwards wandered upon the earth in the greatest melancholy, and dejection.

To what do you think all this refers?

I have no doubt, that any one of these ingenious and beautiful stories may have two or three facts as their basis, upon which the flowery superstructure is reared. Thus, in that of Prometheus, not only some circumstances respecting Adam might be referred to, but in the fact of his drawing fire from heaven, a compliment might be intended, and for a long time a memorial might thus be preserved of him, who discovered the art of striking fire with flint and steel. And with regard to the present allegory, there might have been a Perseus, who mounted a horse of uncommon speed and beauty. There might have been a Bellerophon, who discovered the use of quills, in the art of writing, and who first employed a liquid to give a durable character, to the transient thoughts of the mind. There might have been a philosopher, who, endeavouring to reduce all the operations of nature, all the mysteries of Providence, all the commands of God, to the level of the human comprehension, soared beyond the barrier prescribed for man's attainments, and who, by the intensity of his application, brought on mental derangement. Under this allegory may be veiled the first specimens of this sad malady, this fall from the elevation of a deity, to wander a miserable outcast on the face of the earth. It may allude to those who would have reared a temple, whose top should reach to heaven, but who were sent wanderers over the earth. But, in the grand outlines of the story, stripped of all its pageantry, I think I see the records of a greater event, an event most dire, and here most beautifully portrayed. In Bellerophon I behold Adam, gifted with every bodily and mental faculty, that can adorn human nature. I see him possessed of a highly refined intellect. Upon this he was allowed to mount for all needful, and proper, and devotional, purposes. But when, not satisfied with this, he would still ascend, when he would "be wise" beyond the limit assigned; he falls with a fall so tremendous, that earth at this day groans beneath the pressure of the sad event. The Grecian story says, the horse was placed among the constellations, though the man was left to wander. Mr. Maurice very clearly shows, that the Indian white horse, the prototype of the winged Pegasus of the Grecian sphere, had indeed a very early date*.

How many stars are there in this constellation?

Eighty-nine.

The head of Andromeda, I perceive, touches the body of Pegasus. You have already told me, that she was the daughter of Cepheus and Cassiopeia, but I must inquire how it is, that she is chained to a rock?

We are told that Cassiopeia had so violently offended Neptune, that no concession, short of the exposure of their beloved daughter to the buffeting of the ocean, and to the attacks of a sea-monster, could appease his anger. Cepheus, for the preservation of his kingdom, was obliged to yield. The monster was in the act of devouring his prey, when Perseus, intervening, changed him into a rock. In memory of these events, the rock and Andromeda had places assigned them among the constellations.

I should like to know what this means.

Till it shall be proved, that the four constellations, Cepheus, Cassiopeia, Andromeda, and Cetus, have an origin still more ancient than the settlement of a Chaldean colony in Egypt, I am willing to offer the following explanation. Cetus, I shall presently show, was probably an Egyptian hieroglyphic, expressive of the inundation of the Nile. Hence the determination of the Egyptians to overcome all opposition, may be, the offence given by Cassiopeia to Neptune. By the exposure of the daughter of Cepheus and Cassiopeia, may be intended the yearly influx of the Nile, when the beautiful fields, the pasturage, and the vineyards, were disregarded by the angry monster. Cetus, in the act of devouring his prey, when Perseus intervened, may signify, that the waters of the Nile would have settled into standing pools about the country, and would have destroyed its comfort, and its fertility, had not the ingenuity and industry of the inhabitants confined it to prescribed limits. How well does the concession of Cepheus agree with this! The Egyptians were happy to have their country laid under water once in the year, provided the waters would retain their appointed limits, during the other months. When things were reduced to this orderly arrangement, that which was once terrific, became most lovely; that which had been most dreaded, became the subject of joyful expectation. The Egyptian, associating the subjugated waters of the Nile, to the Andromeda of the sphere, would exclaim, Beautiful when bound. My having asserted, that, with the exception of Cetus, these constellations are clearly recognised among the Hindoos, is no objection to their being of Egyptian origin, since recent researches prove the Indians to have been ancient inhabitants of the higher Egypt.

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* Hist. of Hindoostan, vol. i. p. 210.

Are there many stars in the constellation Andromeda?

Sixty-six.

There are, I see, three small constellations between Andromeda and Aries, consisting of two Triangles and a Fly.

The two Triangles are sometimes regarded as one constellation. They were placed in the heavens, because the most fertile part of Egypt was called the Delta of the Nile, from its resemblance to the Greek letter of that name, which letter is in the form of a triangle △. They contain but 16 stars; and Musca, the Fly, still less, containing but 6.

May I not turn the globe, till I come to Leo Minor? Have you much to tell me about him, mamma?

No. This constellation was made out of the unformed stars of the ancients; and, as you perceive, placed above Leo, the zodiacal constellation, from which circumstance it probably took its name. Though Minor, it contains 53 stars.

I next come to a bunch of hair, with a lady's head-dress encircling it. Will you kindly tell me to whom it belonged?

To the wife of Ptolemy Euergetes, or Ptolemy the Benefactor, for that is what the latter term signifies, having been given alike to Philip of Macedonia, to Antigonus Doson, to all the kings of Syria and Pontus, to some of the Roman emperors, and to Ptolemy of Egypt. Previous to one of the expeditions of this latter personage, Berenice, his queen, vowed, that, if he should return in safety, she would dedicate her hair as a tribute of gratitude to the goddess Venus. Ptolemy returned, and she dedicated her hair; but, shortly after, it was stolen from the temple, when the king intimated to Conon, an eminent astronomer of Samos, the necessity there was for his publicly declaring, that the hair of royalty, dedicated at the altar of gratitude, in the temple of Venus, had been taken by Jupiter into heaven, and by his immediate authority made a constellation.

Well, that was famous; and, I suppose, the people believed it?

As to believing it, I cannot say; but they assented to it, since it would have been injudicious on such an occasion, to have disputed. But be assured, the king, the astronomer, and the thief, were not the only persons, who were well assured, that the reverse of this honour was the fact. In the establishment, and perpetuation of heathen worship, you must not suppose there was no difficulty. There have been freethinkers in every age; and it was probably to evade the force of what they said, and wrote, about their gods, that a set of fables was invented, which threw such a general confusion over their history, that it made mankind uncertain, what to believe, and as unwilling to credit their humanity, as the other parts of their marvellous history.

How many stars are there in this constellation?

Forty-three.

We have now arrived at Boötes, who has in one hand a club, and in the other a cord, which unites the two dogs, Asterion, and Chara, who seem barking at the Great Bear.

But this venerable personage was not always thus degraded to the character of the driver of a bear.

O no, I understand you; for once a wagon supplied the place of that quadruped.

Then Noah appeared, in his true character, as the celestial wagoner, as the honoured personage who first yoked oxen to the plough, and taught mankind the value of agriculture. You remember, that Callistho, perhaps Nimrod, from his incessant attention to Ursa Major, was said to be the son of that constellation, and after his decease his soul was thought to take its abode in Arcturus in Boötes, that it might with uninterrupted attention perpetuate its observations.

What is the number of stars in this constellation?

In Boötes 54, in Asterion et Chara 25.

The last constellation, which I have to name, is Corona, situated between Hercules and Boötes.

This Crown was given by Bacchus, to Ariadne, on the day of her marriage to Theseus. The story of Ariadne is not very dissimilar to that of fair Rosamond, only she lived sufficiently long, to see the little dependence that is to be placed on romantic expressions of regard. Theseus deserted her. Some writers say, she was afterwards married to Bacchus, who, upon her death, assigned to her crown, a place among the constellations. It is composed of 43 stars, 7 of which are very conspicuous.

I will now give you a list of the constellations, to which our attention has been directed.

Constellations.	Number of Stars.	Names of the principal Stars, and their Magnitudes.
1. Mons Mænalus. The Mountain Mænalus.	11	
2. Serpens. The Serpent.	64	
3. Serpentarius. The Serpent-bearer.	74	Ras Alhagus, 2.
4. Taurus Poniatowski. Bull of Poniatowski.	7	
5. Scutum Sobieski. Sobieski's Shield.	8	
6. Aquila. The Eagle. Antinous.	71	Altair, 1.
7. Hercules. Cerberus. The headed Dog.	113	RasAlgethi, 3, in the head of Hercules.
8. Delphinus The Dolphin.	18	
9. Vulpecula et Anser. The Fox and Goose.	37	
10. Sagitta. The Arrow.	18	
11. Lyra. The Harp.	22	Vega, 1.
12. Equulus. The little Horse.	10	
13. Pegasus. The flying Horse.	89	Markab, 2. Scheat, 2.
14. Andromeda	66	Mirach, 2. Almaach, 2.
15. Triangulum. The Triangle.	11	
16. Triangulum minus. The little Triangle.	5	
17. Musca. The Fly.	6	
18. Leo Minor. The little Lion.	53	
19. Coma Berenices. Berenice's Hair.	43	
20. Boötes.	54	Arcturus, 1. Mirach, 3.
21. Asterion et Chara, vel Canes Venatici. The Grey-hounds.	25	
22. Corona Borealis. The Northern Crown.	21	Alphacca, 2.

CHAPTER XVIII.

THE SOUTHERN CONSTELLATIONS WHICH DO NOT RISE IN THE LATITUDE OF LONDON.

With which constellation shall I begin, mamma? Centaurus is very conspicuous; may I select that?

Yes, if you please; there is no deficiency of interest there.

Why, who was Centaurus?

I shall confine my answer to the greatest, the first, the most honourable Centaur.

And who was he, mamma?

He was Chiron, the son of Saturn or Time, which is only an expression under which the Greeks concealed their ignorance of the real genealogy of important personages.

But who was Chiron?

When I tell you, he was one of the precious things "produced from the foam of the churned ocean," I think you will recognise the venerable Noah.

What! again, and on this side the sphere, am I to have the pleasure of seeing the honoured patriarch?

Yes. A grateful posterity thought they never could in characters sufficiently legible record the actions and the honours of this revered man, for not only is Noah the most honourable Centaur, but, "the ark itself was sometimes called Centaurus, and there seem to have been ships of old denominated from the ark, Centauri."

What is he supposed to be doing with that beast, at whose breast he is aiming a spear?

Not only does the attitude of the beast evince, but all the commentators are unanimous, that he is about to sacrifice it on the altar.

That is Lupus the wolf, whom he is about to sacrifice.

So our globe expresses it; but, "wild beast is the Arabian name of the constellation." Fetch me the Bible, and read what it says of Noah's offering, Gen. chap. viii. ver. 20.

"*Noah builded an altar unto the Lord, and took of every clean beast, and of every clean fowl, and offered burnt offerings on the altar.*"

Then we should expect to find Noah offering a clean, and not a wild beast; but let us remember, that the name given to it is of no consequence, but what the animal really is. Now, "the animal, as delineated on the sphere, is no more like any wild beast with which we are acquainted, than it is like any tame one; and, from its forming one of the 48 ancient constellations, may be of Chaldaic origin, and of a race extinct. That the Centaur, and the beast about to be sacrificed, were really of hieroglyphic origin, and that it was under an hieroglyphic veil that all history was anciently shadowed out, there is this strong evidence, that together they anciently formed but one constellation."

Will you not tell me, what the Greeks say about Chiron?

He was, according to their account, a famous musician, also pre-eminently skilled in the medical art, and expert in shooting. He taught mankind the use of plants, gave instructions in the polite arts, and tutored the greatest heroes of the age. But he engaged in war with the Centauri, a people in Thessaly, reported by the uninstructed neighbouring states, to be half men, and half horses, because they for the first time saw them mounted on these swift animals; and he receiving a mortal wound, was placed among the constellations under that form.

I do not wonder at this report being spread about the people of Thessaly; for I have heard, that, when the Spaniards first went to America, the Mexicans thought the same. Pray, how many stars are there in this constellation?

In Centaurus there are 35, in Lupus 24.

Before we proceed to another, I must inquire, what account the Greeks give of that Altar, which you inform me commemorates Noah's *building an altar, and offering burnt offerings thereon.*

It was, they say, made by Cyclops, and was the altar on which the gods swore to revenge themselves upon their enemies, the Titans. It is worthy of remark, that this was one of the earliest of the 48 old constellations. It contains 9 stars.

There are, rather nearer the pole than Centaurus, five or six very small constellations; will you tell me their names, mamma?

Under the body of Centaurus, you will see Crux. There are four stars in this constellation which form a cross, by which mariners, sailing, in the southern hemisphere, readily find the situation of the Antarctic pole. The small constellation, to the south of Crux, is the Musca Australis, the Southern Bee or Fly, consisting of 4 stars. You will perceive, that the next small constellation is a Triangle. It lies across the Antarctic circle: its appellation is, Triangulum Australe, and it contains 5 stars. To the south-east of Centaurus, lie the Compasses, consisting of four stars. The fifth, and last to which you referred, is Norma vel Quadra Euclidis, Euclid's Square or Rule. It has its name from Euclid, a native of Alexandria in Egypt, whose geometry, though he flourished three hundred years before Christ, is still most extensively studied: it encloses 17 stars. In addition to these there are seventeen southern constellations, which do not rise in the latitude of London, and are arranged among the unformed stars of the ancients. As they are the result of the indefatigable attention of modern astronomers, they do not allow of my giving you, in connexion with them, any mythological history. I shall therefore pass over them in the most rapid manner.

Who had the honour, mamma, of completing the sphere of the heavens, begun in so interesting a manner by the ancients?

Dr. Halley. For this purpose, he went to St. Helena, and perfected his catalogue, which on his return he presented to king Charles II.

No wonder, then, that I see Charles's Oak among the constellations; I suppose the Doctor put it there.

You are quite right. Perhaps you can also tell me the reason of his so doing.

To commemorate the preservation of the above-named monarch, when pursued after the battle of Worcester in 1651. *This constellation is, I see, situated at the foot of Centaurus.*

Yes: and it contains 12 stars.

Close to it, I perceive a fish, which appears to be in the act of flying; it reminds me of an Egyptian hieroglyphic.

Then you do not know, that this curious

creature is the link between the inhabitants of the aërial and the watery world. This fish can fly by means of two long fins, while they are damp; and, when they become dry, it drops into the water, and moistens them again. Piscis Volans consists of eight stars; it is situated on the Antarctic circle.

There is another fish, likewise on the Antarctic circle. I know as little of it, as I did about the former.

This is Dorado or Xiphias, the Sword-fish. It derives its name from an animal 20 to 30 feet in length, which sometimes weighs 100 pounds. Its horn is so remarkably hard and strong, that various instances are on record of its perforating the sides of vessels at sea, and causing them to leak. The delineation on the globe does not convey an accurate idea of its size; for it is a small constellation, consisting but of 6 stars.

I observe something very much like an Easel; is that what is intended to be represented?

Yes; you see it is situated between Dorado and Argo, and consists of eight small stars, between which, and Columba is placed Praxiteles, the Engraver's Tools. Between Dorado, and Hydrus the Water-snake, are two constellations, Mons Mensæ, the Table Mountain, consisting of 30 small stars, and Reticulus Rhomboidalis, the Rhomboidal Net, containing 10 stars. Part of this last constellation lies on the Antarctic circle.

The Hydrus, I perceive, lies across the Antarctic circle, and contains a small number of stars.

If you look on the globe, you will be able to tell me the name of a bird very near to Hydrus, which is also on the Antarctic circle, and is composed of a small number of stars.

It is, I notice, Touchan, the American Goose.

Now, will you tell me, what you see between Phœnix, and the pole of the ecliptic?

A Clock.

Yes, Horologium; appropriately consisting of 12 stars; whilst Phœnix, which is at the extremity of Eridanus, contains 13.

At the south pole, there is a constellation of 43 stars. What is its name?

I read the words, Octans Hadleianus: what do they mean, mamma?

Hadley's Quadrant. The stars were constellated under this form in honour of John Hadley, Esq. who invented this instrument for the purpose of discovering the distance, and the height of inaccessible objects.

Tell me the name of a bird of very singular appearance, near to Hadley's Quadrant.

Apus vel Avis Indica.

It has, I think, no legs.

There was a time, when this feathered wanderer, was thought to be destitute of these necessary appendages to the body of a bird, though it is now well known, that he is so equipped. This constellation contains 7 stars.

Near to him is a most curious little creature.

It is the Chamæleon, containing 10 stars.

There are still two constellations, in the Antarctic circle, which we have not mentioned.

What are their names?

Indus and Pavo.

These two constellations contain 26 stars.

Not far from Indus, is a bird, with a long neck, called Grus.

The long neck is appropriate; since the constellation has its name from the Crane. This constellation contains 13 stars. You recollect, I doubt not, my mentioning to you the attainments and sufferings of Roger Bacon.

O yes, I do.

Between Pavo and Corona Australis, you see a tribute of respect to his memory. This Telescope intimates, that he prepared the way for the use of this inestimable instrument.

Are there any more constellations, that do not rise in the latitude of London?

There are two more. One is Corona Australis, the Southern Crown, which appears interwoven with Sagittarius, like a wreath around one of his legs. When we recollect, that Sagittarius was none other than the armour-bearer of Osiris; that Osiris is on the same sphere, and in the same form with himself; that each is about equally distant from the dreadful Scorpion, the malignant Typhon, at whom he is hurling his powerful and destructive arrow, this Crown may intimate to us his successful valour. The other constellation is probably one of the oldest of the 48 great divisions, into which the ancients partioned the visible heavens.

Which is that?

The ship Argo.

What! the ship, in which the Argonautic expedition was undertaken; in which you told me, Jason went?

Such is the Grecian fable; but, since it is scarcely visible in any part of Greece, it surely could not be allusive to the history of that people.

It alludes, then, I suppose, to some still more memorable event?

Yes, my dear child, to an event, of which the whole fable of the Argonautic expedition is only the mutilated narrative.

Is this, then, the ark, in which Noah and his family were preserved?

This, certainly, is one memorial of their miraculous preservation, but memorials were innumerable among his descendants; they were rendered the ornaments on their temples and the decorations on their coins. The memory of this event influenced their religious ceremonies, and guided their solemn festivals. Whilst it was thus operative on land, the daring Phœnician launched into the ocean, and as he aimed at selecting a permanent guide during his voyage, he directed his eye to the spangled firmament, and consecrated the ample range, which enclosed 64 stars, to the memory of his revered progenitor, though one appropriate star became his conductor.

Which was that star, mamma?

It was the bright star in the rudder; this the Egyptians distinguished by the name of Canopus; and it is an interesting fact, that from the same term comes our English word canopy or covering. So that, without any great effort, we see in the ship Argo, the delineation of a canopy, the most interesting, and important, and valuable, that ever covered the defenceless head of man.

Some individual of consequence has, I suppose, had the honour of being introduced to that bright abode.

You are right; and it is interesting to observe, that the solution of every inquiry renders the position I am endeavouring to establish more evident; for it is no less a personage than Japhet, one of the sons of Noah, who was exalted to the celestial sphere under the name of Canopus. And what conjecture can be more probable, than that they, who thus honoured him, retained in their memories the tradition of the fact, that Japhet had attentively guided the rudder, that he had, during the tempest, been the faithful pilot of his father's vessel? In Japhet, we also see the Egyptian god of mariners and the Greek Neptune.

Will you oblige me with a list of the constellations, that have been mentioned during this conversation?

Constellations.	Number of Stars.	Names of the principal Stars, and their Magnitudes.
1. Centaurus. The Centaur.	35	
2. Lupus. The Wolf.	24	
3. Ara. The Altar.	9	
4. Crux. The Cross.	6	
5. Musca Australis vel Apis. The Southern Fly or Bee.	4	
6. Triangulum Australe. The Southern Triangle.	5	
7. Circinus. The Compasses.	4	
8. Norma vel Quadra Euclidis. Euclid's Square.	12	
9. Robur Caroli. Charles's Oak.	12	
10. Piscis Volans. The Flying Fish.	8	
11. Dorado or Xiphias. The Sword-fish.	7	
12. Equuleus Pictorius. The Painter's Easel.	8	
13. Praxiteles vel Cela Sculptoria. The Graver's or Engraver's Tools.	16	
14. Mons Mensæ. The Table Mountain.	30	
15. Reticulus Rhomboidalis. The Rhomboidal Net.	10	
16. Hydrus. The Water-snake.	10	
17. Touchan. The American Goose.	9	
18. Horologium. The Clock.	12	
19. Phœnix.	13	
20. Octans Hadleianus. Hadley's Octant.	43	
21. Apus vel Avis Indica. The Bird of Paradise.	11	
22. Chamæleon. The Chamelion.	10	
23. Indus. The Indian.	12	
24. Pavo. The Peacock.	14	
25. Grus. The Crane.	13	
26. Telescopium. The Telescope.	9	
27. Corona Australis. The Southern Crown.	12	
28. Argo Navis. The Ship Argo.	64	Canopus, 1.

CHAPTER XIX.

THE REMAINDER OF THE CONSTELLATIONS OF THE SOUTHERN HEMISPHERE.

That the statement, which I made relative to the ship Argo at the close of our last conversation, may receive some confirmation, I will immediately direct your attention to the constellations, which formerly occupied the situation next to Argo.

Which are they, mamma?

They are Hydra, the Raven, and Crater: a remarkable assemblage, you will certainly allow, since the stars could with equal propriety have been classed under any other forms.

Their being included under these forms, you think allusive to the same great event?

To Hydra I will direct your attention shortly; but, for a moment, observe the position of the Crow.

It is, mamma, standing on the back of Hydra.

Yes; beautifully illustrative of those words, "He sent forth a raven, which went forth to and from, until the waters were dried up from off the earth." See, its head is bent down, and its wings raised, as if prepared, but yet reluctant to fly. Fetch me the maps I copied about six years since, from Flamstead's Atlas Celestis, and this evening I will furnish you with a portion from one, singularly illustrative of the present observation *.

This, then, represents the raven, which Noah sent out of the ark. Here, also I see the Dove, mamma. Ah! it is close to the ship, coming in with an olive-branch in its mouth.

Your discovery is not exactly to the point. Columba Noachi is not one of the 48 old constellations. But its introduction there intimates, that an impression, similar to that which I am endeavouring to make on your mind, really existed in the mind of the inventor; and, indeed, it seems generally to have prevailed, if we judge from the vast number of aquatic animals, that are found in this hemisphere, but which for a time were buried under the fables of a complex mythology.

So, then, the heroic raven was by the ancients more highly appreciated than the tender dove?

I did not say so; neither did I say, it had not a place on the celestial sphere, but Columba Noachi is not the place.

Tell me, where I may find it, mamma, for I really do not know.

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* Vide Frontispiece.

I have just mentioned to you, and that is all I have done, that formerly the Pleiades were a distinct constellation. The word Pleiades is another term for doves. The season, anciently considered most favourable for setting sail, was the heliacal rising of these stars; and it is believed that at the time of their appearance, the Argonauts set out on their expedition. Nothing, therefore, could be a greater compliment to the faithful dove, than its elevation to this beautiful, delicate, and fortunate assemblage of stars. Thus, without the addition of the more modern constellation, called Columba Noachi, both the dove, and the raven of Noah, have, from an immemorial period, had interesting places among the constellations.

Why was the Crater placed on the back of Hydra, as well as the Raven?

That is an inquiry, which has perplexed wiser heads than yours. The only natural solution of the difficulty is, to admit that it is the hallowed vase, whence the patriarch Noah, the first planter of vineyards, poured libations of wine to that God, who deigned to smell "a sweet savour."

May I inquire, what gloss the Grecians have thrown about these simple facts? What do they say of Corvus?

That it is the crow into which Apollo metamorphosed himself, when he escaped the monstrous giant Typhœus.

And what interpretation do you give to this, mamma?

Apollo, you know, is the sun; Typhon a personification of all that is evil, or bad, or wretched. What then is more natural, than to suppose, that these allegorizing people intended thus to express the obliteration of the sun's rays, and the prevalence of darkness, and storms, and confusion, at the time of the general deluge? Surely, then, the beautiful Apollo was enveloped in some humbler form. Surely the tremendous Typhon had taken to himself absolute authority, and had become king.

What do they say of the Crater?

That it was the bowl of Bacchus, god of wine, from which he poured that exhilarating liquid for his guests. I have observed to you, that there have been several personages of this name; and that Noah is certainly intended in the descriptions given of three of them.

You have not any thing to tell me about Columba Noachi, I fear, as it is not one of the old constellations.

No; but I think I can recollect a curious story, in which the Pleiades form a very conspicuous part.

How much obliged to you I am!

The name of the Pleiades, understood collectively, is, a constellation; and, in Sanscrit, the term used for "a constellation," is Karteek, and Karteek is denominated by the Indians, the general of the celestial armies, or the leader of the host of heaven. "Karteek was the son of Scevas, the god with the lunar crescent on his crown; a dove was concerned in maturing the infant. This delicate creature, too gentle and feeble a nurse for a gigantic progeny, let it fall into the Ganges, that is, the celestial Ganges: the Ganges of the sphere, equally unable to sustain the burden, cast it upon its bank, where it found shelter among the reeds, and there the child grew up a beautiful boy. Beautiful however as he was, Karteek must have perished without proper nutriment; and to prevent his destruction, fortunately there came six daughters of a Rajah, accustomed at that season of the year, to bathe in the stream, and each becoming fond of the child, nourished him, and named him her son.

"Such is the allegory, and though romantic, when unravelled, it will be found equally pertinent and ingenious. Karteek is a constellation formed of the stars called the Pleiades; he is, therefore, properly their offspring, to them he owes his existence. The Indian Ganges, or the Eridanus of the Greeks, commences its course from the left foot of Orion, runs with various convolutions under the sign Taurus, through nearly its whole length; Karteek therefore may properly enough be said to have been cherished on the banks of the celestial Ganges.

"At the time the wild mythology of the Indians was formed, it is probable the year opened in Taurus, and that the Pleiades rose heliacally. By the six daughters of the Indian Rajah, bathing at that season in the Ganges, it should seem, that river then inundated the country, when the sun was in Taurus, notwithstanding it is now at its lowest ebb in May. And it is possible we may thus discover the source of the allegory of the cow-head rocks, through which the Ganges rushes into Hindoostan, but to which no similitude of a cow's or bull's head was ever distinguished by the few travellers who have visited that remote spot in India. It is, therefore, probable, that they mean by this fable to keep alive the memory of an ancient tradition, that the inundation anciently took place, when the sun opened the year in the first degree of Taurus, allegorized by its flowing into India through the head of a rock, called by the name of the sign *." You have had many specimens of Grecian fable: I thought it desirable to give you this illustration of an Indian allegory.

I thank you, mamma: may I inquire how many stars there are in each of these constellations?

In the Raven there are 9; in the Crater 31; in Columba Noachi 10; and in the Pleiades 6; though, there is no doubt, that the Grecian astronomers beheld seven stars there; for they inform us, that thither the seven daughters of Atlas were elevated.

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* Maurice's History of Hindoostan.

But you just now said, that Karteek was nourished by the six daughters of the Rajah, and that the six stars in the Pleiades formed that constellation.

It is true; and this difference has given rise to some very interesting fables. More than six stars might not have been visible for any considerable length of time; the seventh might have been either a comet, or one of the changeable stars, of which I have spoken. But, we may gather, from the union of astronomy, history, and fable, in Ovid, the fact that this star disappeared about the time of the Trojan war.

Will you now tell me, what interesting person, or event, I am to connect with the Hydra?

The multiplied windings of its body intimate, that a memorial of the river Nile is here preserved.

Are we then obliged to the Egyptians for the introduction of this constellation?

It appears evident that this assemblage, a cup, a crow, and a serpent, must be an Egyptian hieroglyphic.

But that is no objection, I suppose, to what you have formerly advanced?

Not the least; for I have already proved to you, that Egypt, in common with the other ancient nations, was formed by a colony of emigrants from Chaldea. It is possible, also, that, under this symbol, the grand deluge itself was typified.

There is, I see, another river on this hemisphere; is it more probable, that, that typifies both the circumstances you have named?

No: that is allusive to another river—a river explored before the advantages of the Nile were known, and constellated before it had the honour of becoming an asterism.

What river is that, mamma?

It is here called Eridanus, formerly "the river of Orion," and previous to that, the "asterism of the river."

But to what does all this refer?

Mr. Maurice shall answer your question. He says, "Now, since we have proved Orion to be no other than Nimrod, this is a convincing proof, that the Euphrates was the river first exalted to an asterism; and, perhaps, it might have been designated as flowing from his foot, either because he first explored its source, embanked the river, or made it navigable." He continues thus: "The Indians, afterwards, borrowing the Chaldean sphere, converted the Euphrates into the Ganges; for, it is surely not a little remarkable, that, according to the Hindoo mythologists, cited in my geographical account of India, the Ganges is said to flow from the foot of Veishnu, an irrefragable proof that the

Ganges is the Grecian Eridanus, and that the mythology originally began in the greater, and not in the lesser Asia*."

What do the Grecians say of these constellations?

Of the Hydra, they give a most dreadful account, which, probably, refers to a serpent, or a number of serpents, in the fens of Lerna; which, after the most severe contest, was at length slain by Hercules. Such, no doubt, was the fact; but, when understood mythologically, it signifies the prevalence of evil, and its final extirpation, by the success of the good principle.

What do they say of Eridanus?

They say it was constellated for receiving Phaeton, the son of Sol, who, having asked the guidance of his father's chariot for one day, set the world on fire. I have already mentioned to you, that this, probably alludes to the appearance of a comet, which, after shining auspicious for some time, disappeared in the constellation Eridanus.

Was not Eridanus the ancient name of the Po in Italy?

Yes; and hence it is we read, that Jupiter, incensed at the presumption of Phaeton, struck him with a thunderbolt, when he fell, but the river Po, in some degree, mitigated the effects of the fall, and for this was constellated. In the Hydra there are 60 stars, and in Eridanus 84.

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* Maurice's History of Hindoostan, vol. i. p. 355; and vol. ii. p. 82.

As you have introduced Orion to me, I cannot delay the pleasure of hearing something more about him.

Nimrod's name, I have, on several occasions, mentioned to you; the record we have in the Bible respecting him is, that he was a mighty hunter before the Lord; a hunter both of men and of beasts; a man who blended the science of astronomy, and the sports of the field; the founder of Babylon, and the sovereign of Chaldea. Give me a description of the way in which you see him drawn on the globe.

I see a very large figure, with a great club in one hand, as long as the extended arm, that bears it; and over the other, which is also stretched out, is the skin of some beast. He has but little attire about him; but from the belt round his waist, a sword is suspended.

Whilst the constellations near him are worthy of notice, he has one foot in the river Eridanus, the other is placed on the back of a Hare; and, at no great distance, are the two Dogs of the sphere, Canis Major and Minor.

What do the Grecian mythologists relate respecting Orion?

That he was the product of the skin of an ox, given by Jupiter, Neptune, and Mercury, to the humble peasant Hircus. Under which wild romance, an allusion may be made, to his enormous power; which rendered obedient to his will, not simply the brute creation, and the untutored labourer, but the whole of animated nature, the waters not excepted. He is said also to have introduced among the colonies some of the first laws of commerce, and to have established the use of, if not to have invented, weights and measures.

The number of stars in this constellation, bear, I suppose, some proportion to the power of the individual here deified.

The number of stars is 87. The ample space formerly allotted to him (for Monoceros is a new constellation), and his conspicuous station, visible alike in the northern and southern hemispheres, are circumstances worthy of notice, as they assist in fixing our attention immoveably upon Nimrod.

Borrowing a hint again from you, mamma, I will request you to give me some information respecting the Hare, and the two Dogs.

I have nothing of interest to communicate respecting the Hare, which contains 19 stars, and appears to occupy its situation in illustration of the character of Orion, or Nimrod.

I observe, in Canis Major, that most important star, Sirius.

Whether the term Sirius be appropriated to a single star, or be applied to the whole constellation, it is certain, that the star in the Dog's mouth was an object of too much importance to Egypt, to remain long undistinguished by its inhabitants.

Why?

On account of an interesting union of circumstances. The inundation of the Nile, which was the source of all the abundance of Egypt, accompanied the rising of Sirius. So that the moment the attentive astronomer saw this blue-eyed maid burst from the fetters of the god of day, an ebullition of national joy, rent the air, and the new year commenced.

Was it, then, because the rising of Sirius, announced with intelligible accents, the inundation of the Nile, that the constellation received its name?

Yes: to this constellation they gave the name of Siris, the most ancient appellation of the Nile; and, having thus designated this most welcome visitant, by the title of their river, they paid it divine honour. The term Siris, signifies benevolent; therefore, with propriety, they applied it to a god, a king, and a constellation*.

I see the constellation; but who was the god, and who was the king?

Of Osiris I have already spoken; and,

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* Memorandum XIII.

there appears the most satisfactory evidence for believing, that Siris, and Osiris, are the same. The Greeks placed the letter *o* before the word; but, in its original form, the Egyptians applied it to the sun, to Noah, and to this assemblage of stars; and, having a peculiar veneration for all that belonged to their great progenitor, they created his consort, their revered Isis; and gave the name of Isis, to the star in the head of Sirius.

You have, I think, mamma, now told me, not only of several situations, which are appropriated to Noah, but also of those occupied by Ham, by Japhet, and now by their maternal parent; but I do not know the destiny of Shem.

He had the honour of becoming the solar deity of the ancient Persians.

Was the Little Dog also regarded as a celestial token, which gave notice of the inundation of the Nile?

Yes: the Little Dog was looked upon with interest, as being the certain forerunner of Canis Major, and declaring, beforehand, the precise time of his approach. These dogs, say the Grecians, were the hounds of Orion.—And here we will not disagree with them; only we must maintain, that the Orion of the Grecian sphere, is the Veeshnu of the Indian, and the Nimrod of the Chaldean sphere; for, where such an exact identity is perceptible, is it likely, that the Grecians could be the inventors of the existing delineations?

How many stars are there in these constellations?

In Canis Major, 31; and in Canis Minor, 14.

The river Eridanus, which flows from the foot of Orion, extends, I perceive, to Cetus. Does not this whale's uncouth appearance point it out as an Egyptian hieroglyphic?

There cannot, certainly, be any reason for giving it a Grecian origin; for, as "the Grecian fable of Cepheus, and Cassiopeia, is to be found in the most ancient Sanscrit books, under the resembling appellation of Capeya and Casyapa, and the legend of Perseus, and Andromeda, is also recorded in the same books under those of Parasica, and Antermada;" it is probable that there also the origin of this terrific representation may be found. While we are amused with the Grecian fable, that this is the sea-monster sent by Neptune, to devour Andromeda, and can sympathize with her in her well-grounded apprehensions of destruction; an event of greater interest appears to me to be symbolized. I behold a colony leaving Chaldea, and, after devious wanderings and many difficulties, taking up their abode on the banks of the Nile. I see them raise their tents, divide their land, and sow their seed; when, in a moment, to their great astonishment, the labour of the year, the hopes and expectations of many months, are swept away.—They are grieved, but not discouraged. Again they plant vineyards, and lay out orchards; again all is destroyed.—Still they set up boundaries and create landmarks, but still the terrific Cetus comes, and with one motion of his jaw swallows up the labours of the whole campaign. Terrific the inundation of the Nile must have been to the first settlers on its shores; though, when its regular return was understood, when a thousand geometrical problems had been solved, to turn this bold invader into a welcome friend; then its approach was hailed with transport.

The situation of the constellation does not oppose the idea. The river which unites Orion and Cetus, coincides with the identity, which once existed between the inhabitants of Chaldea and Egypt. The same river which divides Cetus from Orion, coincides with the distance, at which the Egyptians were removed, while they were yearly the prey to the merciless whale. That such a terrific-looking symbol should exist on the sphere of an enlightened people, was certainly desirable, since it was calculated to perpetuate their exertions, and perseverance, as they were hereby reminded of the advantage of personal energy. That the inundation of the Nile was, at an early period of the Egyptian annals, considerably dreaded, may be argued from their ascribing to the putrid slime of the Nile, the creation of the destructive Typhon. Another probable argument in favour of this supposition arises from Cepheus, the regal personage introduced into this fable, having been the king of Ethiopia, or Abyssinia.

Is there a large number of stars in this constellation?

Not less than 97.

There are, I see, two small constellations to the south of Cetus. What are their names?

One is Fornax Chemica, the Furnace, and the other is Officina Sculptoria, the Sculptor's Workshop: though the former contains only 14, and the latter only 12 stars, they spread over a considerable space in the firmament.

Passing from these constellations, I come to the Southern Fish.

Yes: the Fish, into which, the Greeks said, Venus transformed herself, to escape from the terrible giant Typhon. It is wonderful, that Pleasure, it is more wonderful, that Love, could find an abode any where, when the flood descended, and swept mankind from the earth; but, if, in spite of opposing circumstances, they were to exist, what is more natural than that they should take refuge in one of the inhabitants of the watery world? There are, in this constellation, 24 stars.

I think, mamma, that, by proceeding onwards, beyond the Fish, I have found a Microscope.

You are right; though the Microscope, here delineated, does not resemble that which you are accustomed to use. Microscopes are of three kinds, the single, the compound, and the solar. To the latter it is your happiness to have free access; the compound, is here represented. It comprises 10 small stars.

Are there any constellations which we have not noticed?

Yes; there are five, which are situated near to Argo Navis; but which I could not introduce to you, when speaking of the Ship, without having broken the thread of your inquiries.

There is one, I see, on the rigging of the Ship.

That is Pyxis Nautica, the Mariner's Compass; appropriately situated here on account of its importance to ships at sea. On land, its chief uses are in the exploring of mines, and in desert countries, where it enables the traveller, who would be doubly wearied by the heat of the day, to pursue his course by night to his appointed destination. It is also useful in adjusting the globe, due north and south. This constellation contains 4 stars.

The foot of an Air-pump appears to touch the Mariner's Compass.

This, termed Machina Pneumatica, contains 4 stars.

Monoceros, whose feet touch the rigging of the Ship, looks to me very much like an unicorn.

That is the very thing it was intended to represent. The Unicorn, in which are 31 stars, was introduced by Hevelius.

At some little distance I see Sextans.

It is composed of 41 stars, and is the Sextant. This instrument resembles a quadrant. There is yet one more, which you will not, I conjecture, discover; and, therefore, I point it out to you: Brandenburgium Sceptrum, the Sceptre of Brandenburg, situated west of Lepus and Orion, and consisting of 5 small stars.

And are these really all the constellations, mamma?

Yes; but there yet remain between three and four hundred unformed stars.

I am truly grieved, that our conversations on this subject are now to terminate.

But why so; if the end intended is in any measure answered?

It will, I hope, appear, that several important purposes have been answered; but what is that, mamma, to which you refer?

It was to secure your early prepossessions in favour of the truths contained in the Bible, by laying before you facts illustrative of the Mosaic history. It was incidentally to fasten the religion of our nation and of our Bible, about your heart with an additional bond; since there exists between the Old, and New Testaments, an indissoluble union. It was to fortify your mind against the allurements of Grecian story, and to convince you, that, though their fables shine in gay and beauteous attire, their foundations were laid by older nations, and are allusive to a nobler system of theology.

The constellations upon the globe, now before me, may, I think, be ascribed to four principal sources, the Chaldeans, Egyptians, Greeks, and the modern astronomers.

Are you in possession of any rules, by which the constellations can be attributed to their original inventors?

Those, that relate to the important facts recorded in Scripture history, together with a few connected with agriculture, may be attributed to the Chaldeans; such as are of an hieroglyphic character, to the Egyptians; those, that relate to navigation, to the Phœnicians; the few, of an elegant appearance, to the Greeks; while such as are of a scientific aspect, belong to a much later period.

In bringing these astronomical remarks to a close, I cannot but observe, that they are worthy of the more attention, since every thing, performed by the ancients, connected with astronomy, bears the impress of thought, and plan, and habitual attention.—In confirmation of this, a remark made by Mr. Maurice comes in very appropriately: "Nearly all the hieroglyphic symbols, by which the polar constellations are designated, are remarkable for their slow motion; and even when the figure of the asterism was varied, the idea was still preserved, and the ponderous and tardy Wain was succeeded by the slow unwieldy Bear, an animal that is incapable of taking long journies, and never wanders far from its native regions of the frozen north. By adopting this conduct, the ancients had an astronomical object in view, that of expressing the slow revolution of the high northern constellations round the pole, a point in the heavens to which they were in a manner fastened, and from which it was impossible for them to deviate. For this reason likewise, the Tortoise, that Tortoise, probably, in which the Indian god Veeshnu, in the second avatas or earthly descent, became incarnate; that heavy cumbrous Tortoise, which creeps along upon the earth with such a sleepy pace, was exalted to the polar region, because describing so small a circle in the heavens in comparison of the constellations that are situated nearer the equinoctial line. For the same reason, the constellation of Draco, or the celestial Dragon, was placed so high in the polar heavens; the slow motion of its vast tortuous body, marking the tedious period of its revolution. Hence, too, most probably, Lacerta, or the Lizard, that creeping reptile upon the sphere of earth, and the slow-sailing majestic Swan, were elevated to the same lofty, and frozen station."

While these observations apply to the northern hemisphere, there is one remark, which I will repeat, relative to the zodiac; its remarkable appropriation to the climate of Egypt, while it does not coincide with that of Greece; so that to the former, and not to the latter people it must be attributed; particularly since we find it adorned with their eight principal deities.

Lastly, It may be asked, was it, while every thing on the globe bears the stamp of thought, and plan, and attention, an accidental circumstance, was it unfounded ingenuity, was it Grecian vivacity, in one of her sportive moods, that gave to the southern hemisphere the aspect of a "watery heaven?" If it was not the result of one, or the combination of all these causes, that introduced aquatic or marine objects upon that sphere, how loudly does it proclaim to us, not only the fact of the general deluge itself, but the deep impression which it for a long time made on the minds of the people!

It would, mamma, give me much satisfaction *to possess a separate list of the ancient constellations.*

I shall take great pleasure not only in furnishing you with one, but also with a delineation of the 48 old constellations*, and with a statement of those introduced by Hevelius; but, for the sake of uniformity, I had better now give you a list of those, that have been the subjects of the present conversation.

Constellations.	Number of Stars.	Names of the principal Stars, and their Magnitudes.
1. Hydra.	60	Cor Hydræ, 1.
2. Corvus. The Crow.	9	Algorab, 3.
3. Crater. The Cup or Goblet.	31	Alkes, 3.
4. Columba Noachi. Noah's Dove.	10	
5. Eridanus. The River Po.	84	Acherner, 1.
6. Orion.	78	Bellatrix, 2. Betelgeux, 1. Rigel, 1.
7. Canis Major. The great Dog.	31	Sirius, 1.
8. Canis Minor. The little Dog.	14	Procyon, 1.
9. Lepus. The Hare.	19	
10. Cetus. The Whale.	97	Menkar, 2.
11. Fornax Chemica. The Furnace.	14	
12. Officina Sculptoria. The Sculptor's Shop.	12	
13. Piscis Notus vel Australis. The Southern Fish.	24	Fomalhaut, 1.
14. Microscopium. The Microscope.	10	
15. Pyxis Nautica. The Mariner's Compass.	4	
16. Machina Pneumatica. The Air Pump.	3	
17. Monoceros. The Unicorn.	31	
18. Sextans. The Sextant.	41	
19. Brandenburgium Sceptrum. The Sceptre of Brandenburg.	3	

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* See the Catalogue, in Memorandum XV.

CONCLUSION.

CONCLUSION.

Having brought before your view, facts so dear to me, and so desirable, for you to know, I cannot close this work without expressing the constant pleasure I have felt, and the unutterable gratitude I still feel, that I am allowed to lay before you, subjects so majestic, and of such stupendous importance. The universe has appeared to us as the palace of the Deity; and, while we have surveyed nature with the eye of an astronomer, we have seen that nothing can be more splendid, more correct, or more amazing. We have beheld this universe extending infinitely every way, but still cheered and animated by the presence of the great Lord of all. We have beheld immense and shapeless masses of matter, formed into worlds by his power, and dispersed at intervals, to which even the imagination cannot travel. In this great theatre of his glory, a thousand suns, like our own, animate their respective systems, appearing and vanishing at divine command. We have seen our own bright luminary, fixed in the centre of its system, wheeling its planets in times proportioned to their distances, and at once dispensing light, heat, and action. The earth also is seen with its two-fold motion, producing by the one, the change of seasons, and by the other the grateful vicissitudes of day and night. With what silent magnificence is all this performed, with what seeming ease! The works of art are exerted with interrupted force, and their noisy progress discovers the obstructions they receive: but the earth, with a silent steady rotation, successively presents every part of her bosom to the sun, at once imbibing nourishment, and light, from that parent of vegetation and fertility.

But not only are provisions of light and heat thus supplied, but its whole surface is covered with a transparent atmosphere, that turns with its motions, and guards it from external injury. The rays of the sun are thus broken into a genial warmth; and while the surface is assisted, a gentle heat is produced in the bowels of the earth, which contributes to cover it with verdure. Waters are also supplied in healthful abundance to support life, and assist vegetation. Mountains arise to diversify the prospect, and give a current to the stream. Seas extend from one continent to the other, replenished with animals, that may be turned to human support; and also serving to enrich the earth with a sufficiency of vapour. Breezes fly along the surface, to promote health and vegetation. The coolness of the evening invites to rest; and the freshness of the morning renews for labour*.

Such are the delights of the habitation that has been assigned to man: without any one of these, he must have been wretched; and none of these could his own industry have furnished. But, while many of his wants are thus kindly supplied on the one hand, there are numberless inconveniencies to excite his industry on the other. This habitation, though provided with all the advantages of air, pasturage, and water, is but a desert place without human cultivation. The lower animal finds more conveniencies in the wilds of nature, than he who boasts himself their lord. The whirlwind, the inundation, and all the asperities of the air, are peculiarly terrible to man, who knows their consequences, and, at a distance, dreads their approach. The earth itself, when human art has not pervaded, puts on a gloomy appearance. The forests are dark and tangled, the meadows overgrown with rank weeds, and the brooks stray into a determined channel. Nature, that has been so kind to the lower order of beings, has been quite neglectful with regard to him; to the savage uncontriving man the earth is an abode of desolatian, where his shelter is insufficient, and his food precarious. A world thus furnished with advantages on the one side, and inconveniencies on the other, is the proper abode of reason, is the fittest to exercise the industry of a free and thinking creature: those evils which art can remedy, and prescience guard against, are a proper call for the exertions of his faculties, and they tend still more to assimilate him to his Creator. God beholds with pleasure that being which he has made, converting the wretchedness of his natural situation, into a theatre of triumph, bringing all the headlong tribes of nature into subjection to his will, and producing that order and uniformity upon earth, of which his own heavenly fabric is so bright an example. These remarks are capable of being enlarged to a very considerable extent, and of being directed to the most important purposes, and they reduce themselves to this plain position, that God has done much for us, but has left much for us to do. So that, though there are large demands to be made upon our gratitude, there are not inferior calls upon our activity. In the organization of the human frame, in the philosophy of the human mind, how ample is the illustration! In the great outworks of nature, where art could not reach, God himself has operated with amazing tenderness, and perfection. Anatomists best skilled in the human frame see nothing that is redundant; nothing that is deficient*. When we survey the animal economy on this side, we see nothing but the process of a designing and a benevolent Creator.

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* Goldsmith's Animated Nature.

We see the body fitted up with an assemblage of bones, muscles, and vessels. We see these bones not carelessly thrown together, but most artificially arranged. The SKULL, for the reception of the brain, differs from all the great cavities of the human body: they are all enclosed by membranes; but the importance of the BRAIN to life, and the extreme tenderness of its substance, made a solid case necessary, and such a case the hardness of the skull supplies, completely surrounding its contents, being calculated not for motion, but solely for defence. These hollows likewise, and inequalities, on the inside the skull answering exactly to the folds of the brain, serve the important design of keeping the substance of the brain steady, and of guarding it against concussion. If we pass from the skull, to the spine, or BACK BONE, we shall see it present a chain of very wonderful construction. Firmness, and flexibility, are so dexterously united, that, while we have free motion, the junctions and overlappings of the bones, present in all ordinary cases, a complete guard against dislocation. The way in which the RIBS are united to the back bone is truly wonderful, and the play of the LUNGS is provided for by the enlargement and contraction of the chest; for the ribs are not articulated at right angles, but obliquely; so that whatever pulls the ribs upwards, at the same time draws them outwards.

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* Note I.

In the NECK two things were to be done: the head was to have the power of bending forward and backward, and of turning itself round upon the body to a certain extent; for these two purposes two distinct contrivances are employed. First, the head rests immediately upon the uppermost of the vertebræ, and is united to it by a hinge-joint; upon which joint, the head plays freely forward and backward. This was the first thing required *. But then the rotary motion is unprovided for; therefore, to make the head capable of this, there is, not between the head and the uppermost bone of the neck, but between that bone, and the bone next underneath it, a projection somewhat similar in size and shape to a tooth, which tooth entering a corresponding hole or socket in the bone above it, forms a pivot or axle upon which that upper bone, together with the head which it supports, turns freely in a circle, and as far in the circle as the attached muscles permit the head to revolve: thus are both motions perfect, without interfering with each other.

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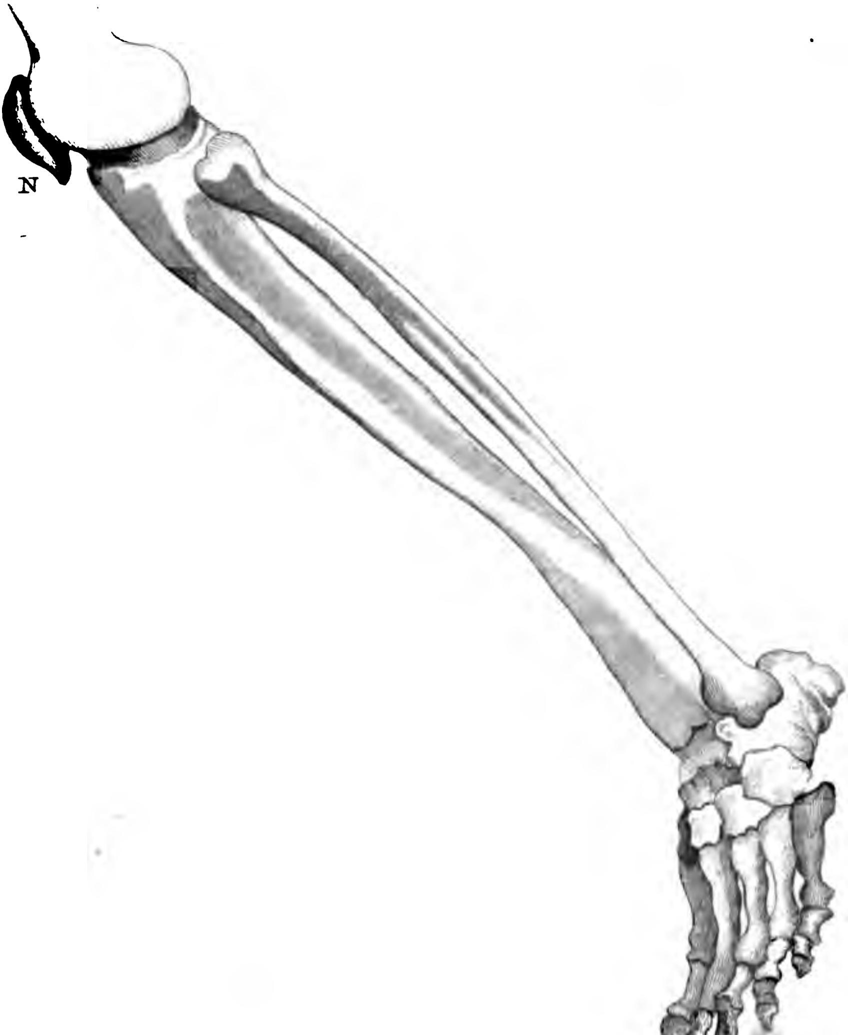
* Dr. Paley's Natural Theology.

If we descend to the ARM, how important the demand, but how ample the provision! In the fore-arm, where, for the perfect use of the limb, two motions are wanted, a motion of the elbow, backwards, and forward, and a motion by which the palm of the hand may be turned upward; to effect this, the fore-arm is made to consist of two bones lying alongside each other, but touching only towards the ends: one, and only one, of the bones is joined to the cubit, or upper part of the arm, at the elbow; the other alone to the hand at the wrist. The first, by means, at the elbow, of a hinge-joint, swings backward and forward, carrying along with it the other bone, and the whole fore-arm. In the mean time, as often as there is occasion to turn the palm upwards, that other bone to which the hand is attached rolls upon the first, by the help of a groove, or hollow, near each end of one bone, to which is fitted a corresponding prominence in the other. If both bones had been joined to the upper arm at the elbow, or both to the hand at the wrist, the thing could not have been done. The SHOULDER BLADE is a singular bone, evidently intended to furnish a basis, to which the arm might be articulated; for, properly speaking, it forms no part of the skeleton, being attached to it only by muscles.

If we pass from the arm to the LEG, we shall find that no less artificially arranged. Any one casting his eye on the drawing I have given, and directing his attention to N, must be astonished at the appearance of the patella or knee-pan, evidently intended to protect both the tendon, and the joint from injury.

The joints in the human body dividing themselves into three classes, namely, the hinge joint, and the mortice and tenon joint, are truly wonderful. To select but one illustration — the joint in the ancle. This is defended from dislocation by two remarkable processes, or prolongations of the bones of the leg; which processes form the protuberances that we call the inner, and outer ancle. It is part of each bone going down lower than the other part, and thereby overlapping the joint; so that if the joint be in danger of slipping *outwards*, it is curbed by the *inner* projection, i. e. that of the tibia; if *inwards*, by the *outer* projection, i. e. that of the fibula.

It is worthy of remark, because it is easy of illustration, when sitting around the social board, that our bones are not left in a rough state, to come in contact with each other, but the end of each bone having received a most appropriate, often a most artificial form, is tipt with *gristle*, so that the surface is most beautifully smooth. Who has not observed this in the ball and socket joint? How truly wonderful is it, that, close to every joint, there is a contrivance, not simply for the preservation, but actually for the formation of a certain mucilage,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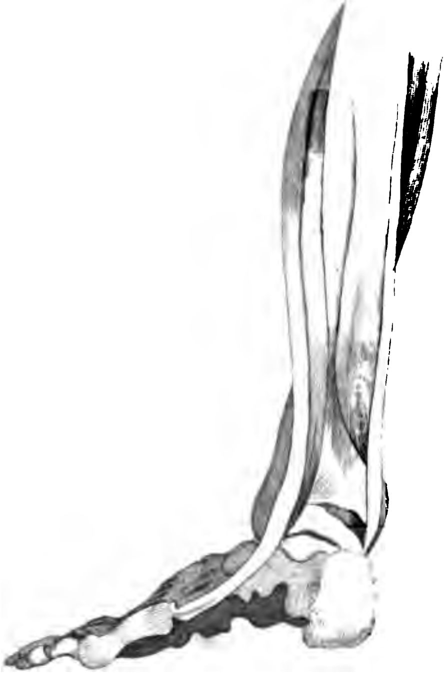

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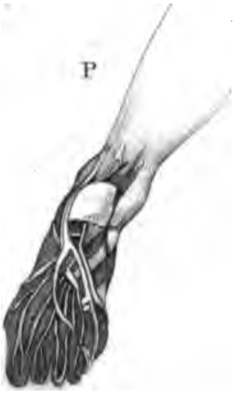


which drips its "balsamic contents," upon the hinge, and keeps it moist, and fit for action!

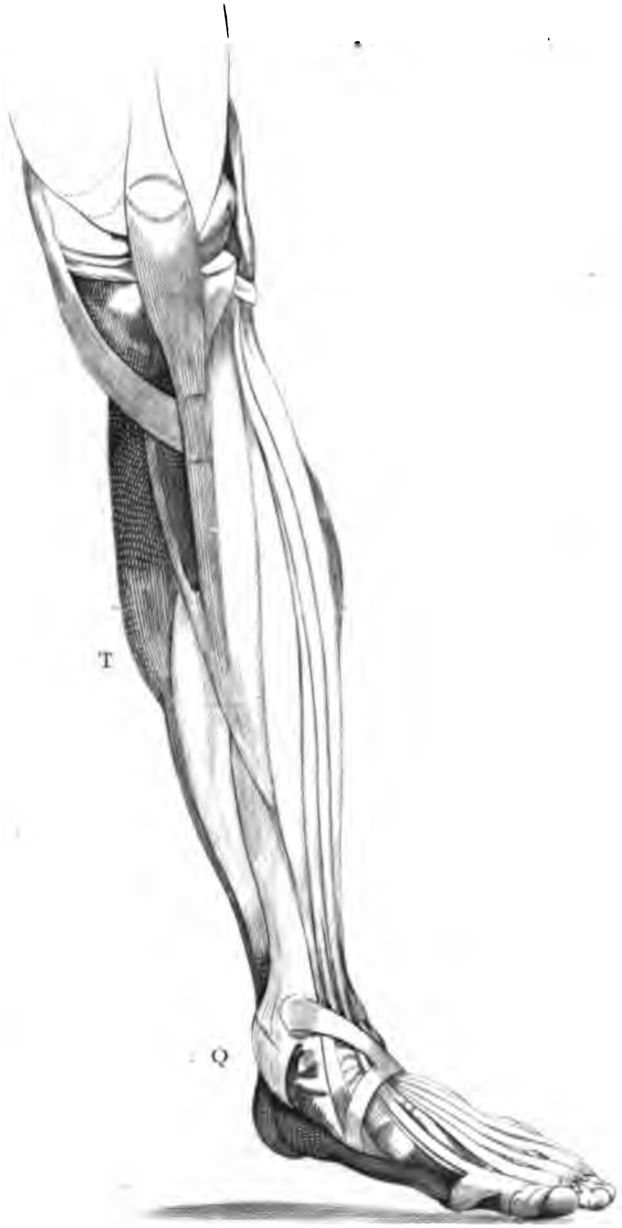
The formation of the FOOT I cannot leave unnoticed. It does not consist of one bone of the form of the outer surface; but each foot is composed of twenty-seven bones, which circumstance in its structure is, no doubt, one reason of our standing with so much safety and ease upon so small a pivot. It is also worthy of observation, that even when the whole of the lower part of the foot is perfectly fitted up with muscles, and veins, and the adipose membrane, the whole does not rest upon the ground; much less is this the case in the skeleton; as may be seen by a reference to my drawing, where it is shown, that the bones of the foot are concave underneath, that the vessels, tendons, and nerves meeting under the foot, may not be subject to pressure [P].

But a system of bones alone would present a useless spectacle; for, though they are so wonderfully articulated, there would be a most surprising defect without MUSCLES: for instance, it is not merely by a most curious structure of bones, that a man turns his head, but by virtue of an adjusted muscular power that he even holds it up. Keill has reckoned in the human body 446 muscles, dissectable and describable, and has assigned an use to every one of the number. Bishop Wilkins has observed, that there are at least ten qualifications, to be attended to, in each particular muscle: its proper figure; its just magnitude; its fulcrum; its point of action; its collocation with respect to its two ends; the place, the position of the whole muscle; the introduction into it of nerves, arteries, and veins.

How worthy of admiration is the fact, that "whatever motion the joint, by its mechanical construction, is capable of performing, that motion the annexed muscles by their position are capable of producing!"

Feign would I select one instance of muscular organization so striking, that the mind should be immediately sensible of the thought, the care, and the tenderness of the Divine Contriver. Though the following is by no means a solitary instance, yet still it is, without doubt, a satisfactory illustration.

The foot is placed at a considerable angle with the leg. It is therefore obvious, that flexible strings, passing along the interior of the angle, if left to themselves, would, when stretched, start from it. The obvious preventive is to tie them down. And this is actually done: just above the instep is placed a strong ligament, under which the tendons pass to the foot, and are thus securely bound down, as a slight glance at the delineation will evince [Q]. There is one difficulty respecting the muscles, which we find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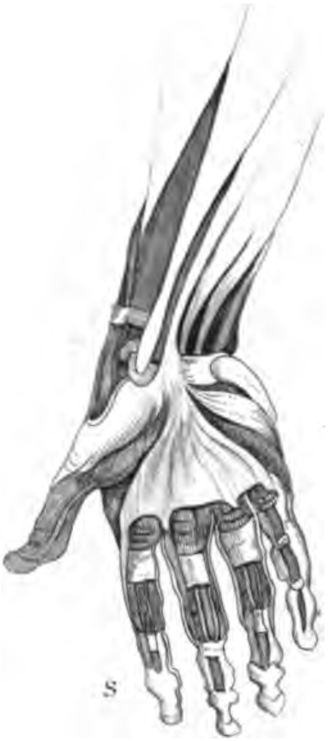
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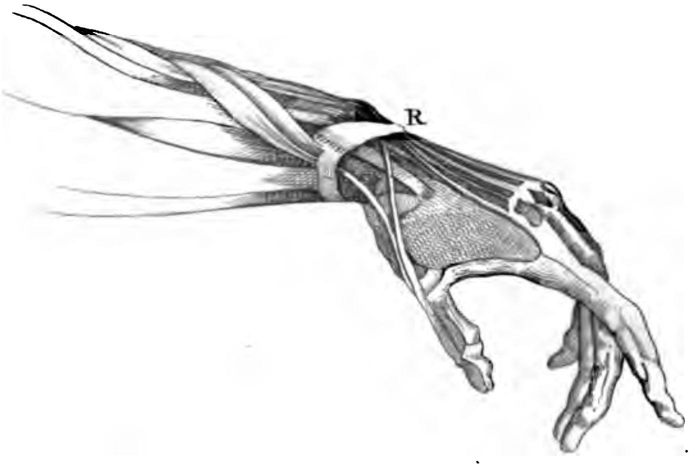
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most admirably adjusted. "Their action is wanted where their situation would be inconvenient;" in which case the body of the muscle is placed in some commodious position, at a distance, and made to communicate with the point of action by slender strings or wires. If the muscles which move the fingers had been placed in the palm, or back of the hand, they would have swelled that part to an awkward or clumsy thickness. The beauty, the proportions of the parts would have been destroyed. They are, therefore, disposed of in the arm, and even up to the elbow, and act by long tendons strapped down at the wrist [R], and passing under the ligaments to the fingers and to the joints of the fingers [S], which they are to move. The same remarks apply to the muscles which move the toes, and many of the joints of the foot: how gracefully are they disposed of in the calf of the leg [T], instead of forming an unwieldy tumefaction in the foot itself! The observation may be repeated, of the muscle which draws the nictitating membrane over the eye. Its office is in the front of the eye; but its body is lodged in the back part of the globe, where it lies safe, and does not destroy the beauty of the external appearance: were but one so formed, how would others wonder, how would all admire!

"Because 't is common is the blessing lost."

In addition to *bones* and *muscles*, there is in the human frame a system of BLOOD-VESSELS, which distribute to every nook and corner of the body, the nourishment which enters at the mouth. It is easy to conceive a large main trunk branching off by smaller pipes, and conveying the fluid wherever it is needed; but it is not so easy to conceive how this fluid shall be carried back again to its original source; but this is provided for by a reversed system of vessels united at their extremities, with the extremities of the first system, so that they collect the divided and subdivided streamlets, first by capillary ramifications, into large branches, and then by these branches into trunks, and thus return the blood (almost exactly inverting the order in which it went out) to the fountain whence its motion proceeded. "The body, therefore, contains two systems of blood-vessels, arteries and veins. Between the constitution of the systems there are also two differences, suited to the functions which the systems have to execute. The blood, in going out, passing always from wider into narrower tubes; and, in coming back, from narrower into wider; it is evident, that the impulse and pressure upon the sides of the blood-vessel will be much greater in one case than the other. Accordingly, the arteries which carry out the blood, are formed of much tougher and stronger coats, than the veins which bring it back. That is one difference: the other is still more artificial, or, if I may so speak, indicates, still more clearly, the care and anxiety of the Artificer. For, as in the arteries, by reason of the greater force with which the blood is urged along them, a wound or rupture would be more dangerous than in the veins, these vessels are defended from injury, not only by their texture, but by their situation; and by every advantage of situation that can be given to them. They are buried in sinuses, or they creep along grooves, made for them in the bones: for instance; the under edge of the ribs is sloped and furrowed, solely for the passage of these vessels. Sometimes they proceed in channels, protected by stout parapets on each side; which last description is remarkable in the bones of the fingers, these being hollowed out, on the under side, like a scoop, and with such a concavity that the finger may be cut across to the bone, without hurting the artery which runs along it. At other times, the arteries pass in canals wrought in the substance, and in the very middle of the substance, of the bone: this takes place in the lower jaw; and is found where there would, otherwise, be danger of compression by sudden curvature."

But though the *bones*, the *muscles*, and the *vessels* separately are truly wonderful, yet here we have only the organization of a dead body:

to put the system in a state of activity a further provision is necessary, a communication with the brain by means of NERVES. We know the existence of this communication, because we can see the communicating threads, and can trace them to the brain; its necessity we also know, because, if the thread be cut, if the communication be intercepted, the muscle becomes paralytic. But a body thus far formed, and then left, would present a disgusting spectacle. How is it, then, that the human frame always presents an object of decency, sometimes of considerable beauty? Much of this is effected by means of the intervention of the *cellular*, or adipose membrane, which lies immediately under the skin, which is moist, soft, slippery, and compressible, every where filling up the interstices of the muscles, and forming thereby their roundness, and flowing lines, as well as the evenness, and polish of the whole surface. Here then is a wondrous, a living, and a beauteous mass, which with the outworks of the interesting structure is complete. At the extremities of the fingers, and the toes, little shields are placed, operating alike for defence and for beauty; the hair of the head for decoration; and the voice to praise Him who hath made us thus. But still all would be useless if there were no contrivances for hearing, seeing, smelling, and tasting. Lightly to touch upon each of these parts of the human body, would not sufficiently illustrate the perfection of the organic construction. To dilate the wonders of each would be inconsistent with the conciseness of this essay. I shall, therefore, select one, and that one shall be the EAR, because, perhaps, it usually excites less attention than the eye.

"Its general form, both external and internal, shows that it is an instrument adapted to the reception of *sound;* that is to say, already knowing that sound consists in pulses of the air, we perceive in the structure of the ear, a suitableness to receive impressions from this species of action, and to propagate the impressions to the brain. For of what does this structure consist? An external ear (the concha), calculated, like an ear-trumpet, to catch and collect the pulses of which we have spoken; in large quadrupeds, turning to the sound, and possessing a configuration, as well as motion, evidently fitted for the office of a tube which leads into the head, lying at the root of this outward ear, the folds and sinuses thereof tending and conducting the air towards it: of a thin membrane, like the pelt of a drum, stretched across this passage upon a bony rim: of a chain of moveable and infinitely curious bones, forming a communication, and the only communication that can be observed, between the membrane last mentioned, and the interior channels, and recesses of the skull: of cavities, similar in shape and form to wind instruments of music, being spiral, or portions of circles: of the Eustachian tube, like the hole in a drum, to let the air pass freely into, and out of the barrel of the ear, as the covering membrane vibrates, or as the temperature may be altered: the whole labyrinth hewn out of a rock; that is, wrought into the substance of the hardest bone of the body. This assemblage of connected parts constitutes together an apparatus, plainly enough intended for the transmission of sound, or of the impulses received from sound; and it is only to be lamented, that it is not better understood.

"The communication within, formed by the small bones of the ear, is, when we look upon it, more like what we are accustomed to call machinery, than any thing I am acquainted with in animal bodies. It seems evidently designed to continue, towards the sensorium, the tremulous motions which are excited in the membrane of the tympanum, or what is better known by the name of 'the drum of the ear.' The compages of bones consists of four, which are so disposed, and so hinge upon one another, as that if the membrane, the drum of the ear, vibrate, all the four are put in motion together: and by the result of their action, work the base of that which is the last in the series, upon an aperture which it closes, and upon which it plays, and which aperture opens into the tortuous canals that lead to the brain. This last bone of the four is called the stapes. The office of the drum of the ear is to spread out an extensive surface, capable of receiving the impressions of sound, and of being put by them into a state of vibration. The office of the stapes is to repeat these vibrations. It is a repeating frigate, stationed more within the line. From which account of its action may be understood, how the sensation of sound will be excited, by any thing which communicates a vibratory motion to the stapes, though not, as in all ordinary cases, through the intervention of the membrana tympani. This is done by solid bodies applied to the bones of the skull, as by a metal bar holden at one end between the teeth, and touching at the other end a tremulous body. It likewise appears to be done, in a considerable degree, by the air itself, even when this membrane, the drum of the ear, is greatly damaged. Either in the natural or preternatural state of the organ, the use of the chain of bones is to propagate the impulse in a direction towards the brain, and to propagate it with the advantage of a lever; which advantage consists in increasing the force and strength of the vibration, and at the same time diminishing the space through which it oscillates: both of which changes may augment or facilitate the still deeper action of the auditory nerves.

"The benefit of the Eustachian tube to the organ may be made out upon known pneumatic principles. Behind the drum of the ear is a second cavity or barrel, called the tympanum. The Eustachian tube is a slender pipe, but sufficient for the passage of air, leading from this cavity into the back part of the mouth. Now, it would not have done to have had a vacuum in this cavity; for, in that case, the pressure of the atmosphere without would have burst the membrane which covered it. Nor would it have done to have filled the cavity with lymph or any other secretion: which would necessarily have obstructed, both the vibration of the membrane, and the play of the small bones. Nor, lastly, would it have done to have occupied the space with confined air, because the expansion of that air by heat, or its contraction by cold, would have distended, or relaxed the covering membrane, in a degree inconsistent with the purpose which it was assigned to execute. The only remaining expedient, and that for which the Eustachian tube serves, is to open to this cavity a communication with the external air. In one word, it exactly answers the purpose of the hole in the drum.

"The membrana tympani itself likewise, deserves all the examination which can be made of it. It is not found in the ears of fish; which furnishes an additioual proof of what indeed is indicated by every thing about it, that it is appropriated to the action of air, or of an elastic medium. It bears an obvious resemblance to the pelt or head of a drum, from which it takes its name. It resembles also a drum-head in this principal property, that its use depends upon its tension. *Tension* is the state essential to it. Now we know that, in a drum, the pelt is carried over a hoop, and braced, as occasion requires, by the means of strings attached to its circumference. In the membrane of the ear, the same purpose is provided for, more simply, but not less mechanically, nor less successfully, by a different expedient, viz. by the end of a bone (the handle of the malleus) pressing upon its centre. It is only in very large animals that the texture of this membrane can be discerned *."

In the Philosophical Transactions for the year 1800 (vol. i.) Sir Everard Home has given some curious observations upon the ear, and the drum of the ear, of an *elephant.* He discovered in it, what he calls a radiated muscle, that is, straight muscular fibres, passing along the membrane from the circumference to the centre; from the bony rim that surrounds it towards the handle of the malleus, to which the central part is attached. This muscle he supposes to be designed to bring the membrane into unison with different sounds: but then, he also discovered, that this muscle itself cannot act, unless the membrane be drawn to a stretch, and kept in a due state of tightness, by what may be called a foreign force; viz. the action of the muscles of the malleus. Supposing his explanation of the use of the parts to be just, our author is well founded in the reflection which he makes upon it: "that this mode of adapting the ear to different sounds, is one of the most beautiful applications of muscles in the body; the mechanism is so simple, and the variety of effects so great*." To confim and illustrate what has been said, I have furnished the reader with a map of the ear, which I have reduced with considerable attention, from a valuable engraving.

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* Dr. Paley's Natural Theology, p. 42—47.

While the care that is obvious in the formation of the ear, manifests itself alike in every part of the human body, we cannot but observe, with what amazing skill, and tenderness, God himself has deigned to work. Here he has displayed a father's liberality, because our best efforts would have been ineffectual. Suppose for one moment, that, after having put the animal body together, it had been required of us to keep the heart in motion, to direct the

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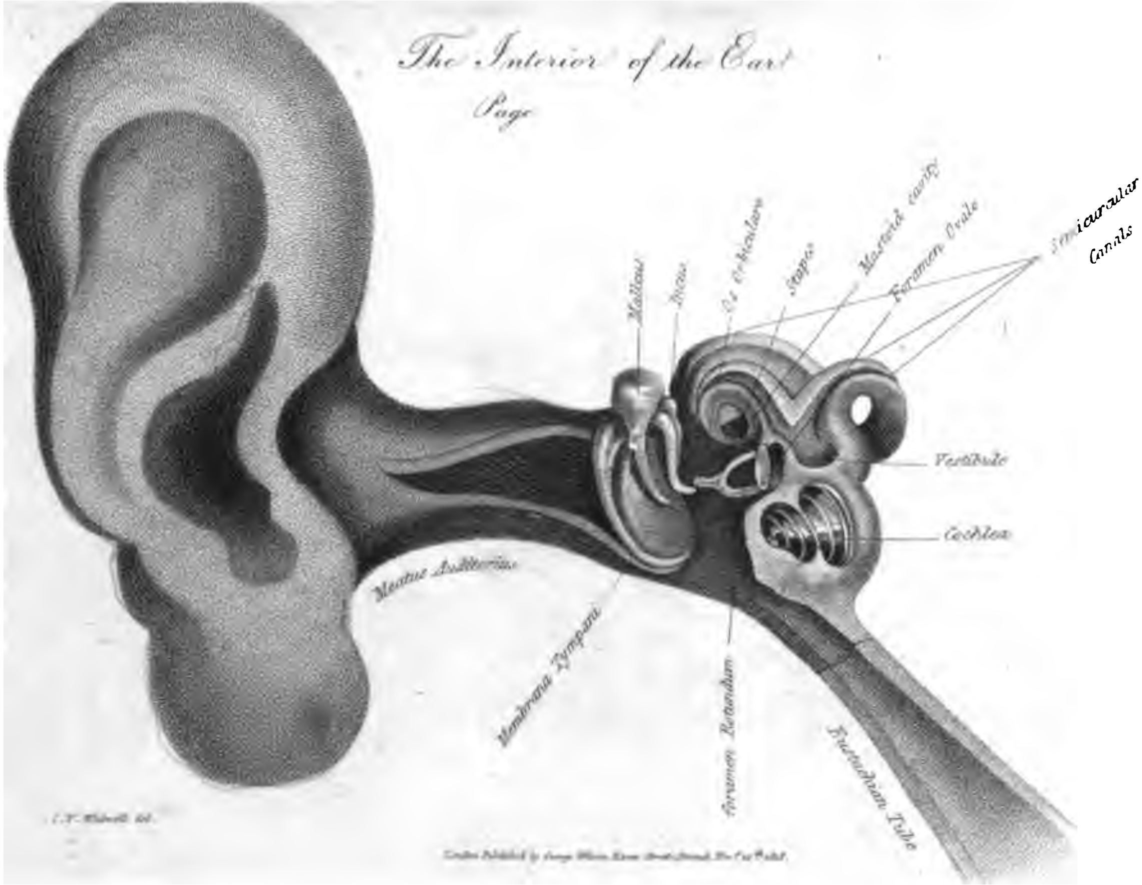
* Dr. Paley's Natural Theology.

The Interior of the Ear

Page



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flux and reflux of the blood through the arteries and veins, to supply the hinges or joints with oil, that they should play freely in their sockets, to lift up the eyelids with our hands, whenever we wished to see, to keep the outer surface of the eye moist by the application of a purifying liquid; I ask, what would our lives have been? surely, but one act of devotion to ourselves, without the possibility of cessation, or of recruiting our strength by sleep. But all this, and a multitude of other important ends, are secured by involuntary motion: and yet, while all this is done for us, much, very much, remains for us to do. Every year's bill of mortality, our numerous hospitals, our visits to the chambers of sickness, our personal experience, announce this. In fact, such is the quantum of that which remains for us to do; that, with the hope of having the list perused, I am obliged to take the relation from a poet, whose name is so entwined with all that is elegant, that, perhaps, even this will not be offensive: he says,

"Numbers of all diseas'd; all maladies
Of ghastly spasm, or racking torture, qualms
Of heart-sick agony, all fev'rous kinds,
Convulsions, epilepsies, fierce catarrhs,
Intestine stone, and ulcer, colic pangs,
Demoniac frenzy, moping melancholy,
And moon-struck madness, pining atrophy,
Marasmus, and wide-wasting pestilence,
Dropsies, and asthmas, and joint-cracking rheums.

> Dire was the tossing! deep the groans! Despair
> Tended the sick, busiest from couch to couch:
> And over them triumphant Death his dart
> Shook; but delay'd to strike, though oft invok'd
> With vows, as their chief good, and final hope.
> Sight so deform what heart of rock could long
> Dry-ey'd behold *?"

Now, the mitigation and cure of all these diseases depend upon ourselves; the mighty catalogue dwindles beneath the indefatigable labours, the patient investigation of an Esculapius. How much does increased attention to the science of chemistry promise? How many thousands of lives have been lost by poisons, which might have been saved, had the physician been in possession of the chemical science? Every inspiration we take, and every pulse that vibrates within us, effects a chemical change upon the animal fluids; and, in proportion as the nature of the operation is understood, will life be perpetuated, or rendered comfortable, while it is continued.—And while we contemplate with delight, the progress of medical knowledge; may we not believe that, for every malady nature has furnished a remedy, that the remedy is within our reach, and requires but the hand of industry to bring it forth?—To present but one illustration: What encouragement does the origin and progress of the variolous inoculation afford? The yearly average of

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* Milton, Book XI.

deaths by the small-pox in London only, till within the last ten years, used to amount to more than 2020 persons.

In Edinburgh, according to Dr. Monro, one tenth of the whole population have been cut off by the small-pox.

In France, the proportion of deaths by the small-pox has been one fifteenth of the whole mortality. According to Dr. Colon, from 60 to 72,000 fell annually by the disease. In one year 15,000 were cut off in Paris alone. And, in another particular year, Dr. Moreau says, not less than 20,000 died of it.

At Montpelier, in one year, 6000 out of 32,000 inhabitants died of the small-pox.

In Rome, 6000 perished in six months.

In Palermo, 8000 died in one year; and in Naples, twice that number.

In Geneva, according to Dr. Odier, about one in twenty, fell victims to the small-pox.

At the Hague, the deaths by the small-pox amounted to more than one in thirteen.

In Germany alone, this disorder destroys 70,000 persons annually, or nearly 200 per diem.

From Dr. Timoni's account, it appears, that, at Constantinople, before the adoption of inoculation, even one half of those infected with small-pox have fallen victims to it.

Dr. Macdonald, of Hamburgh, calculates,

that the small-pox proves fatal to forty million every century; Dr. Sacco, of Milan, to sixty million; and Dr. Lettsom, of London, to twenty-one million in Europe alone, which should make his computation amount to not less than one hundred million; the other quarters of the globe being so much more extensive than that of Europe, and the people so ignorant of the medical art.

The small-pox is said to have been so malignant in Russia, as to have destroyed annually two millions of the subjects of that vast empire.

In China, where the population is immense, the numbers who annually die of the small-pox, are incalculable.

In India, the mortality occasioned by the natural small-pox, has been prodigious; no less than one, out of three, have died of it.

Now, it is very satisfactory to have discovered, not simply, that there is a preventive for all this, but that the preventive is one most simple in its nature; and though the heart, capable of one grateful emotion, will ever beat responsive to the name of Jenner, yet, had it not been for the observation of some country people, who remarked that the receiving of the cow-pox, protected the constitution from the small-pox, this glorious fact would still have remained among the secrets of nature, and this consolatory information would not have been wafted from shore to shore.

These observations address themselves to us, not simply as intellectual, but as accountable creatures; they come to us announcing the same great truth respecting religion, God has done much for us, but he has also left much for us to do. How can I epitomize what God has thus done for us? I shudder at a task so hard, but the necessity of the attempt unavoidably flows from the character of this essay.

God at first created man in a holy and happy state, and filled him with heavenly dispositions, so that his mind, yielding to the influence of sovereign benevolent energy, every volition was pure, and every thought unsullied. In this situation, a temptation presented itself, which being well adapted to the intellectual mind to which it was addressed, succeeded. The dire results of disobedience soon manifested themselves; nature, all in harmony, became deranged; the passions, sweetly subservient, broke forth in dreadful convulsions; enmity to God and man was the characteristic of the mind, so lately the residence of heavenly purity, and, instead of communion with God on earth, being with smiles exchanged for more immediate communion in heaven, the dark cold grave was the end of a journey through a valley of tears. But was this state of things for ever to to exist?

That was impossible; the rancour and ill-will of the human species would soon have swept them from the earth, had not a potent remedy been provided; but a remedy was found, most astonishing, most incredible, and in every way suited to the wants, and necessities of man. For, while all the calamities that wring our hearts, that draw down the copious floods from our eyes, all the pains which extort so many groans, with every shock of mortality which depopulates our cities, may be traced to the former source; all freedom from pain, all intellectual enjoyment, all social intercourse, all the comforts of home, all the endearments of friendship, yea, every mitigating occurrence during the fatigues of our journey, our composure in death, our anticipation of a glorious resurrection, and of an inheritance for ever in heaven, all these we owe to the ample remedy which God has provided. While, also, there is a multitude of truths which admit of demonstration, this, that a Saviour has actually appeared to put away sin by the sacrifice of himself, is THE TRUTH around which God has allowed an effulgency of light to shine, an irradiation of glory to appear, which no other truth admits; and the reason we do not see and feel all this, is, that besides the reading usual to a cultivated mind, we do not add the perusal of the Bible; or, if we do peruse that blessed book, it is not with the docility of children; we do not take it up as an infallible oracle, embrace it with a warm-hearted glow of gratitude, as having found the only antidote for the maladies of man. I therefore do earnestly recommend each individual to examine for himself, and I am sure it will appear, that there is a remarkable order in the events, and predictions, respecting this great Restorer of human nature; it will be obvious, that there is an astonishing clearness in the prophecies, an amazing accuracy in the delineation of the nature, and character, of the person and offices, of the Messiah, of the circumstances attending his birth, of the miracles he should perform, and the treatment he should meet with, while an interesting dependence between the Mosaic, and the Christian economies, exhibits itself.

But this is not the only description of subject that the Bible presents. The attentive examiner will find a number of historic facts, and remarkable prophecies, which must have produced, in the minds of philosophers of every age, a conviction of the existence and superintendence of God; such as the universal deluge, the multiplication of languages, the destruction of Sodom and Gomorrah, prophecies respecting Babylon, Tyre, and Egypt, the destruction of Jerusalem, and the state of the Jews. The whole history of the Israelites presents one grand series of interventions; and, though these were confined to a peculiar people, yet an amazing publicity was given to them, by the removal of the Hebrews from Canaan to Egypt, and from Egypt back again to Canaan.

He will find the plan of Providence developing itself in the raising up suitable instruments for the accomplishment of his great design; such as Cyrus, Alexander, and Augustus*. And as he proceeds in his research, he will discover, that the canon of Scripture does not close without instructing us in the nature and excellencies of God, in the wants, and the principles of human nature, in an exhibition of what we ought to be, in a full assurance of an eternity of duration; without presenting everlasting happiness to the righteous, and misery to the wicked; without addressing us by every motive which can warm the heart, and elevate the mind; without adding encouragement to encouragement, and heaping up recompense on reward; without appointing an external and visible church; without instituting two standing ordinances to be perpetuated to the end of time; without consecrating one day in seven for the immediate service of God, and allowing us on that, and on every other day, to offer up our desires to Him, with confession of our sins, and thankful acknowledgments of His mercies; or without adding the assurance, that the influences of his infinite Spirit, shall act upon our finite minds, to subdue the enmity which subsists in them to the administration of God, and to renew in our hearts, holy and heavenly volitions.

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* Note II.

All this God has done, and yet the world remains a wilderness! because we expect that God should, in the manifestation of Himself to us, not only adapt religion to our infirmities, but accommodate it also to our inveterate vices. We not only require Him to present the antidote to our infirmities, but we demand our infirmities to be removed *without the application of the remedy.* We wonder that so little is done; we forget that we ought to be doing. We are alive to the fact, that every age has presented its peculiar errors; we forget that it is for us to stem the torrent, and in our persons exhibit what it is capable of effecting. This fact, that each revolving century presents its fashionable error, shows both the necessity of action, and the extent of those duties which devolve upon us. O! could the man of this world, the cold-hearted moralist, be persuaded to believe, that he has never yet beheld religion as it is, that he has always seen it in the deformity of those, who call themselves, its friends! O, could he see that it stands an inflexible pyramid amidst the tempestuous ocean of changing fashions, and that the time advances when the tempest shall subside, when it shall be evident that nothing is lost of the stateliness of the edifice, by its presenting to the world the full force of its colossal beauties!

When we set ourselves seriously to the task of examination, what is more obvious than that the observances of religion must borrow their aspect from the character of its professors?

It is impossible that a refined Grecian, that a rude barbarian, should manifest his belief in the stupendous fact of man's redemption in exactly the same way. Then why should the ignorance, the imbecility of man, be placed to the account of that very system, which has made him so much better than he would otherwise have been? Since the downfall of the Roman empire, there has not been a period, in which religion could shine forth, with all that matchless elegance, with all the spotless purity, with which revolving centuries will present it to the future view of mankind.

What were the circumstances, which occasioned the downfall of this empire? Was it not the indolent, and vicious luxury of her people, was it not the influx of rude barbarians, wild as the countries whence they sprang? Now, see this inestimable treasure in the hands of these two bodies of people, and tell me, whether, (though it might not be embraced by them) indolence would not do something, whether ignorance would not do more, to debase it? Mark the establishment of the feudal system, and see what opportunity there was for the display of the mild virtues of religion. Mark the fanatical wars of the crusaders, and observe, if this was not probably the only means of keeping religion alive in the world, the whole world composed of a set of ruffians; but still mark the unhallowed channel through which Heaven's best gift had to pass. This brought in the age of chivalry, and presented to mankind some most lovely evidences of what religion can do*. But still this heavenly flotilla, glided upon an ocean of dreadful impurity, and under the mask of piety, sins so enormous were committed, that they will never be blotted from the memory of man: no; these are the offences that led to the grand Reformation; but, while they brought in a reformation, the deadly effects hang even upon us, and it is *with difficulty we can separate the purity of religion, from the impurity of its professors*. But the time is coming. Civilization has taken a grand march; the arts and sciences are loved, and cherished, and blessed; learning is reviving in every quarter; and, I trust, the best of all learning, will ever be cultivated, as a nation duly appreciates the subordinate arts.

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* Note III.

Now, these observations address us most forcibly; for we see how much depends upon us. If we will, we may leave to our children the midnight darkness of Popery; if we will, we may give them religion, as it came pure from the hands of God: and I plead this day, that we may thus present it to them: but, for this purpose, we must give them an education large, liberal, and comprehensive; we must not let them believe there are no difficulties in the way to heaven, but, tenderly presenting these obstacles, we must enable them to remove them all.

Much has been said of the slow progress of Christianity*. I confess I do not myself see it. This grand majestic car travels on the beaten road of ordinary occurrences: its contraction within narrow limits, or its running triumphantly throughout the world, depends on the spirit of its people. Let their minds be prepossessed in its favour by a liberal education; let their hearts be warmed in its cause by experience; in their lives let them exhibit a genuine and a heavenly purity, and there will be no occasion to complain of the slow progress of religion.

Among a thousand interesting plans, by which Religion may be presented to the world as a heavenly visitant, all-beauteous as she is, that which peculiarly devolves upon the teachers of youth, is to render her lovely to their young associates. Situated as we are, we see the world in varied forms. We see encircling the brows of a certain set of people a contraction, a littleness, at which the mind recoils. Let the soul be preparing for heaven ever so rapidly, let her days and nights be one uninterrupted hosanna of gratitude to God, if she is not walking on the hair's breadth which they have marked out, agreeable to their theory, all is wrong. In other persons we see a liberality too extensive, a liberality detrimental to the dissemination of the religion of the Bible. Both these extremes should be avoided, if we would not have our successors lament, that, in receiving religion from us, it passed through so impure a channel. How desirable it is, that when they shall be able to read, to think, to combine, they shall not only bless God for his revelation, but that it has been so ably expounded by the lives of their associates. Say, would it not remove half the barrier we have had to surmount; and might not the time, which has been spent by us in solving the problem, how it is that the lives of nominal Christians are so unworthy, be by them devoted to making new plans for the melioration of society, for the lessening of its calamities, for the increase of its bliss. Certain I am, that the time is advancing, when a nation of people shall as much exceed the Greeks and Romans, as the Greeks and Romans, when at the summit of their elevation, excelled the Huns, and Goths, the Vandals, and Visigoths: for, though their excellent forms of government, their rigid attention to the arts both of peace and war, their active spirit of patriotism, and their strong attachment to their mythology, raised them to an elevation, which impresses astonishment on our minds, yet let us remember that but half the human species enjoyed the advantages which their history describes. In the politest ages of Greece, were not females condemned to ignorance, to labour, and to obscurity? At the time of their greatest magnificence, vice was tolerated; the gratification of revenge was honourable; suicide was a virtue; their gods were gold and silver, wood and stone. At that we should not shudder; but every vice was deified, every crime was patronized by a god. Now, I say these people were great; but it is an unavoidable result, if we will but be diligent, in cultivating all the arts, and all the sciences, and if we will let these be, only handmaids to our patriotism and to our religion, only helpers in serving our God, that our own nation must be greater still. Cicero hesitates not to assert, that to their piety, to the firm belief in an overruling Providence, the Romans were indebted for their ascendancy over all other nations. Now, if the belief in false gods had such a mighty influence, what must be the effect of Grecian refinement, of Roman literature, when distributed equally to each sex, and when grafted upon Christian principles: principles not such as have been exhibited in the world, but such as stand uncontaminated in the Bible? The effect will be the developement of a "new earth, wherein dwelleth righteousness."

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* Note IV.

It would be easy and delightful to pursue this theme, to mark how the passions, and selfish views, the diligence, and noble conduct of individuals, and how times, and circumstances, act in subserviency to this grand event. But, to direct the mind to one fixed point, and exhibit one scheme of probable utility, and then furnish three or four arguments in its favour, may be more useful than to leave the imagination to range in an extensive scene; where, indeed, the pasture is verdant, but the paths are devious.

Any idea I have to offer must necessarily be connected with the object of my constant attention. Female education then is the topic: a subject of such commanding importance, that it requires the head of a politician and legislator to do it justice. Education was a theme to which Milton and Locke thought it their honour to yield attention: it may then, with propriety, be inquired, who is it that ventures to advance, and offer her views on such a subject? The individual is humble, indeed, but the whole of her career has furnished one act of dedication to this important topic. For seven years of her life, metaphysical works were her meat, and her drink; days and nights were devoted to the gratification of this insatiable appetite. It was impossible, thus to fail of acquiring some little insight into the established laws of the human constitution. This period has been most unexpectedly succeeded by seven years of practical investigation of these laws; and the combination of these circumstances has placed, in a most overwhelming point of view, the necessity of presenting to the youthful mind science in its simplest, its noblest, its most general, and commanding point of view: and the rapid progress in improvement, the habitual good will during the hours of business, and the amiable deportment of pupils, whose studies are directed by an attention to this rule, during the periods of relaxation, create a considerable degree of anxiety to give it a much wider circulation.

It has been an inquiry of some interest, how this may be effected; and, the most probable means appear to be, the union of forty or fifty ladies, who are heads of seminaries, and members of the Established Church, into an association, by which means there might be a constant and friendly exchange of sentiments on the subject of education. By this consolidation of work, talent, and piety, independent seminaries which have shone as so many glittering stars in the firmament, would appear with the importance and splendour of the sun; but to give this association all that weight and influence which it is desirable it should possess, to give to its laws all that wisdom which they ought to display, and all that knowledge of human nature which they must evince, it is important that it should be under the patronage and direction of one or more of the dignitaries of the church, who should be identified as the fathers of the rising generation.

Such is, very briefly, the idea I have to present. To enter more into the detail is unnecessary at this time; and as the catechetical part of this work is offered with a considerable degree of timidity, and has been withheld, till, with propriety, it could be kept back no longer, I shall have credit for descending from general topics, to a particular point, with increased emotion. The arguments I have to offer in its favour, I trust, will furnish an apology for my zeal and anxiety in the cause.

I cannot but be aware, that there are a multitude of individuals, who look upon any deviation from the beaten track, as the rash effort of a warm imagination, that may please and dazzle for a time, but can produce no real or lasting benefit. This idea might be applicable on the present occasion, were my views connected with any violent depreciation of those plans, still in use in female seminaries, or if any indecorous precipitation in the work of amendment were urged; but my object is simply to *facilitate* that mental improvement which is working its way, and to furnish a permanent foundation, upon which its towering eminence may stand secure, one effect of which would be, that, instead of individuals being borne unconsciously by the tide of popular opinion, they would recognise the fact, that the education of their daughters is reduced to a system, and that it is the subject of certain, fixed, well-known, and general laws.

Who is not anxious that such an education should become national, as would concentrate in one individual, extremes the most opposite? and this will doubtless be the result of the progress of reason, and a judicious diffusion of knowledge. Is it not desirable that the mind should possess a considerable portion of information, and yet the individual remain modest and retiring? that, with much decision of character, a polite attention to the opinions of others should be united? that, with a scrupulous regard to the value of time, there should be sweetness and complacency in the society of our connexions; so that, solitude should be bliss, and society the source of delight? that, with a mind fitted for contemplation, the attention should be alive to the ten thousand little comforts of life? that, with a keen penetration into personal defects, a mantle of tenderness should be cast around the failures of others? that, with a low estimate of personal attainments, should be united a readiness to allow whatever is excellent in others? that, profound piety should exist, without superstition; a liberal state of mind, without laxity; and a spirit of investigation, without scepticism? That such a combination is not often to be found, is the idea I have imbibed: but all this is essential to the perfection of the female character; and to the due maintenance of that exalted station which she holds in the community, by which, unseen, she gives energy to her sons, and by her virtues, or her vices, insures a nation's prosperity, or, with accelerated aggravations, hastens its downfall. Since such are the effects of female influence, and a combination of all the excellencies just enumerated is rare, yet, as the assemblage is occasionally found, it appears to be desirable, that those who would facilitate our national improvement, should trace out the general principles of our nature, which have been acted upon, when such a result has exhibited itself.

What was the object aimed at by several enlightened citizens, when the arithmetical skill of an American youth displayed itself? It was to obtain the basis upon which his deductions were founded, that the application of the principle might be rendered subservient to the more rapid progress of ordinary capacities. In connexion with this subject, how important is a remark made by Lord Bacon: "Rules," says he, "do, in some sort, equal men's wits, and leave no great advantage or pre-eminence to the perfect and excellent motions of the spirit. To draw a straight line, or to describe a circle, by aim of hand only, there must be a great difference between an unsteady and an unpractised hand, and a steady and practised; but, to do it by rule or compass, it is much alike."

The rapid spread of intellectual improvement during the last twenty years, is surely encouraging to any one willing to enter upon the task of its increased advancement; and it is the first argument I offer, in soliciting attention to the idea of an association of female seminaries.

To what art or science can we direct our attention, in which the progress is not truly interesting? Shall the subjects be geography, and navigation? The glowing language of a celebrated writer, relative to the former science, cannot be improved: he says, "The reign of George III. will stand conspicuous, and proudly pre-eminent in future history, for the spirit with which discoveries were prosecuted, and the objects of science promoted; and a dawn of hope appears, that ere its close, the interesting problem of a north-west passage from the Atlantic to the Pacific will be solved, and this great discovery, to which the Frobishers, the Hudsons, the Davis's, Baffins, and Bylots, so successfully opened the way, will be accomplished." And, doubtless, the increased knowledge of the science of navigation will not be without its advantages in facilitating the solution of this problem. Such are the laws to which navigation is reduced, that a seaman, though ignorant of mathematics, may apply with correctness and dexterity the rules for finding the longitude." The progress which has been made in astronomy, anatomy, and botany, is proverbial; and has this arisen from the retrograde motion of some sister science? no; but from the aid they have received from the increased proficiency of the optician. Indeed, upon the sciences of astronomy, and mathematics, the eloquent and philosophical statement of the argument by M. Condorcet, cannot fail to carry conviction to the mind. His words, as translated by Dugald Stewart, are, "To such of my readers as may be slow in admitting the possibility of the progressive improvement of the human race, allow me to state, as an example, the history of that science in which the advances of discovery are the most certain, and in which they may be measured with the greatest precision. Those elementary truths of geometry, and of astronomy, which, in India, and Egypt, formed an occult science, upon which an ambitious priesthood founded its influence, were become, in the times of Archimedes and Hipparchus, the subjects of common education in the public schools of Greece. In the last century, a few years of study were sufficient for comprehending all that Archimedes and Hipparchus knew; and, at present, two years employed under an able teacher, carry the student beyond those conclusions which limited the inquiries of Leibnitz and of Newton. Let any person reflect on these facts: let him follow the immense chain which connects the inquiries of Euler, with those of a priest of Memphis: let him observe, at each epoch, how genius outstrips the present age, and how it is overtaken by mediocrity in the next; he will perceive that nature has furnished us with the means of abridging, and facilitating our intellectual labours, and that there is no reason for apprehending that such simplification can ever have an end. He will perceive, that at the moment when a multitude of particular solutions, and of insulated facts, begin to distract the attention, and to overcharge the memory, the former gradually lose themselves in one general method, and the latter unite in one general law; and that these generalizations continually succeeding one to another, like the successive multiplications of number by itself, have no other limit, than that infinity which the human faculties are unable to comprehend."

In proportion as the mind becomes familiarized with these ideas, will it be stimulated to action, not simply by the consideration of how much is done; but by the conviction of how much there still remains to do; so much that it seems to require uncommon vigour to qualify for the combat, an unusual character of mind, that dares calculate upon the bliss of victory. The immense achievements yet to be made, is my second argument.

We are still only emanating from the darkness of the sixth, and seventh centuries. We are but on the march from the tyranny of ancient prejudice, to the perfection of human reason; we are only emerging from that oppressive bondage, upon which the old system of policy was founded, and on the skilful exercise of which, its influence has been so long perpetuated. We are but half way upon our journey between the time, when every thought, on every subject, was made to yield before the terrors of the Inquisition; and that auspicious period when the perfection of human society shall render the execution of sanguinary laws unnecessary, and the whole science of legislation shall be reduced to a few, grand, and simple, precepts. But surely the greater part of our difficulties are surmounted, and the certainty of our progress, is more obvious, than could have been the advances made by our predecessors. The following argument drawn from Stewart's Philosophy of the human Mind, must be truly encouraging to those whose energies fail, because the combat is severe. He observes, "Of the progress which may yet be made in the different branches of moral and political philosophy, we may form some idea, from what has already happened in physics, since the time that Lord Bacon united in one useful direction, the labours of those who cultivate that science. At the period when he wrote, physics was certainly in a more hopeless state, than that of moral and political philosophy in the present age. A perpetual succession of chimerical theories had, till then, amused the world, and the prevailing opinion was, that the case would continue to be the same for ever. Why then should we despair of the competency of the human faculties, to establish solid and permanent systems, upon other subjects which are of still more serious importance? Physics, it is true, is free from many difficulties which obstruct our progress in moral and political inquiries; but, perhaps, this advantage may be more than counterbalanced, by the tendency they have to engage a more universal, and a more earnest attention, in consequence of their coming home more immediately to our 'business and our bosoms.' When these sciences too, begin to be prosecuted on a regular and systematical plan, their improvement will go on with an accelerated velocity; not only as the number of speculative minds will be every day increased by the diffusion of knowledge, but as an acquaintance with the just rules of inquiry, will more and more place important discoveries, within the reach of ordinary understandings."

If, after what has been said, it still remains the subject of inquiry, why I am anxious to press home, the importance of female education, and to trouble the public with my views on the subject, I can only say, it was not the *solitary* exertions of a Nimrod, a Hercules, or a Semiramis, that raised those stupendous monuments of human skill, which have excited the admiration of succeeding ages. No: it appears to be the sole prerogative of the Infinite Mind to act alone. When finite minds would effect any great object, it must be by the concentration of their powers by the union of their influence; it must be the act of the multitude, not of an individual.

It is, perhaps, almost unnecessary, as an argument in favour of the cause I plead, to point out some circumstances respecting the state of society in the United Kingdom. It is a well-known fact, that a large part of the community are not members of the national established Church: that, on the one hand, the Catholics, daily augment in number, and that the Dissenters, split into forty or fifty subordinate divisions, form a large mass of the population. In addition to this, we cannot but expect an influx of gaiety, and some revival of infidelity, from the closer and more general intercourse that exists between us, and our continental neighbours; whose vices are the more likely to be adopted by us, since they are covered with an exterior garb, which must captivate every individual of taste, and feeling.

During the season of confinement to our country, which a long war imposed, there was time for many of the important truths of religion to be rivetted in the minds of our people; but how few can grasp the whole of a subject! and each department of the community pursues the division of truth, which falls in with some darling prejudice, or some favourite object. Hence, many of the precepts of the sacred writings have been imbibed by our populace, without any knowledge of the relation in which they stand to other parts of the Holy Scriptures. Hence, this doctrine of the equality of mankind, supposed to rest upon this infallible basis, has been proclaimed, without considering, that social order, and universal subordination, are founded on the laws of nature, and unavoidably impose themselves upon each individual who becomes a member of society; without considering the fact, that to enjoy liberty aright, the foundation on which it rests must be generally understood, and that the light of philosophy must first be universally extended. To the statement of one fact, without its indispensable associate being kept in view, I apprehend we may trace much of that insubordination obvious in various departments of the community. Hence, a practical exhibition of the import of these precepts, "Be courteous," "Honour all men," appears as though it might be beneficial to our associates. But while we would duly appreciate, and diligently cultivate that which is admirable in the French character, there is great danger of imbibing some of the odious maxims of their policy.

What then is to be done? Shall we place around our island a barrier more formidable than the ocean, to check the unparalleled activity of our people in their visits to the continent? Shall we do what we can to prevent their seeing an habitual exhibition of the finest feelings of our nature? Shall we seclude them from the world, and then boast of their decision of character?

This will not do; we must supply an antidote, as extensive as the malady, and exactly suited to its nature. We must give to the rising generation, solid and permanent principles; yea, principles more permanent, and more solid, than those by which the world has hitherto been governed. Need I say, then, that this is my third argument in soliciting, at this juncture, the dignitaries of our church to come forward, and fix the wavering opinions of the community, by giving the impress of their own exalted minds, to the rising generation? Their patriotic spirit, their natural and acquired endowments, and their paternal connexion with the community, render it particularly desirable that they should enter seriously upon the important business of directing the established laws of our constitution to purposes worthy of their divine origin; and that, after having devoted themselves to this important engagement, they should place the result in the hands of all those heads of seminaries who shall willingly be guided by such regulations. By this, not only, would a degree of stability be given to the opinions of the community, but the improvement of female education in the British empire would be, in a ratio infinitely greater than any thing that has been witnessed at present. Lord Bacon well observes, " expert individuals can execute, but the general counsels, and plots, and the marshalling of affairs, come but from those that are learned."

There is yet one consideration which I must beg permission to mention. It is the encouragement to be derived from a belief in the ultimate perfection of the human character; when a variety of attainments shall adorn the mind, when an assemblage of graces shall exhibit themselves in the person, and when the beauty of these, shall be heightened, and refined, by the most pure, and unaffected devotion to God.

I grant, that, to a mind incapable of taking an extensive survey, not only individuals, but nations, and empires, appear to be disposed of, as the caprice of fortune may direct; they sink and rise alternately as the intrigues of the cabinet, or the chances of war may direct. To such a mind, it only appears, that every age has produced heroes and politicians, that all nations have experienced revolutions, and that all histories are nearly alike. But, I venture to affirm, that, to a mind capable of making the survey, there will appear to be but three grand periods in the history of the world. The first of these extends itself, from the creation, to the deluge. That, during that period, rapid advances were made in the arts and sciences, there can be no doubt: but, was it not indispensable, that the descendants of the first transgressor should be swept from the earth, to mark the malignity of his offence, and to typify that destruction to which all the species were subject? Hence, though succeeding ages doubtless lamented the loss of the stately edifices, of the colossal labours of that period, we cannot but bow with submission to the will of Him, who thus proclaimed our lost condition. In consequence of the new covenant, we find another race of men repeopling the earth, and we are introduced to a second grand division of time, which extends from the deluge, to the death of our Lord Jesus Christ. After the deluge, three important preventives to the spread of deteriorated morals were furnished. The life of each individual was materially contracted, languages were various, while only one was understood by each party; in addition to which, the inhabitants of the renovated world, were widely dispersed. Though these circumstances were indispensably necessary to secure the good order of society, they greatly retarded the progress of improvement: but, at length, the arts and sciences broke through every impediment, and once more stood pre-eminent in the world. The inhabitants were again refined in intellect, but corrupt in practice; once more they abounded in all the conveniences and luxuries of life, but they were " filled with all unrighteousness, fornication, wickedness, covetousness, and maliciousness; they were full of envy, murder, debate, deceit, malignity, whisperers, backbiters, haters of God, despiteful, proud, boasters, inventors of evil things, disobedient to parents, without understanding, covenant-breakers, without natural affection, implacable, unmerciful." Such was the state of society when ineffable Purity made its appearance among mankind. They, with one burst of astonishment at his presence, exclaimed, " We will not have this man to reign over us;" and so fixed was the resolve, that they exterminated infinite goodness, spotless perfection, unsullied graces, from the earth. They affixed the brightness of the Father's glory, the express image of His essence, to a cross, and, (can I write it?) exclaimed, " Away with such a fellow from the earth!" Surely the high dignity of the Sufferer, could never have been believed, if a blackness of darkness had not fallen on the human species, of which the darkness at His crucifixion was but a faint emblem. The rocks were rent, and nations, which till then, by their tame submission, appeared to be dead, came forth; they broke down the middle wall of partition, which, till then, had divided the barbarians, from the citizens of Rome; and they retired not; but shook, and convulsed, and agitated, the guilty world, till nearly every ray of intellect was swept away by the fierceness of Jehovah's wrath.

This tremendous transaction in the history of the human species is past. It conducts us to a third grand division in the history of the world. Of this period, eighteen hundred years have already elapsed; and, we cannot doubt, that the fall and rise of kingdoms are intimately connected with the sins of man, or the extent of the Redeemer's empire. But this, I apprehend, is a subject which will be placed in a much more commanding point of view, when, to succeeding ages, the history of mankind shall be explained on great and general principles.

The use I make of the above observations, in connexion with the hope of the future perfection of the human species, is, that as no action can in any degree resemble those which are past, but the wilful neglect of submission to the authority of God, in opposition to light and evidence; we trust that such a complete extinction of all mental improvement will never again take place. There appears, also, reason to believe, that as the human species have suffered in consequence of the death of our Lord

Jesus Christ, they will, in their collective capacity, be blessed, in virtue of His resurrection. And while we indulge the hope that the repetition of such a scourge will not again be requisite, so the possibility of it appears to diminish.

Security unknown to the Romans is furnished against the irruptions of barbarians, by the alterations which have taken place in the art of war, in consequence of the invention of fire-arms, and the modern science of fortification.

Another, and a much more interesting source of national security arises from the discovery of this important fact; that "the wealth of each nation, so far from depending on the poverty and depression of its neighbours, is intimately connected with their industry and opulence; and, consequently, those commercial jealousies, which have hitherto been a fertile source of animosity among different states, are founded entirely on ignorance and prejudice."

In addition to these considerations, it has been well observed, that the art of printing ought, no less than the art of writing, to be considered as a step in the natural history of mankind, by which a most astonishing influx of knowledge is furnished, a consequent preventive to ignorance is provided, and as long as the freedom of the press remains, an antidote to slavery is secured.

It is a most important law of our constitution, that we are never stationary; we are either receding from excellency, or are on the march to higher degrees of perfection. Now, could the idea fully occupy our minds, that, while in the faithful discharge of our duties, we are not subject to a lapse into ignorance and degradation, we should have a most important stimulant to press forward, and we should even accelerate that event, which we look upon as infinitely distant.

Whatever be the interval, it cannot be disputed, that to seize the grand, prominent, and capital features of a subject, and to place them before the youthful mind, stripped of all bewildering impediments, is a dictate of common sense, and it appears probable, that the result will be beneficial, since this was the conduct pursued by Lord Bacon, by Kepler, and by Newton. It was indeed the rock upon which Luther rested, and which made his exertions so productive of the happiness of mankind. In applying it to the education of our children, it is desirable it should be pursued on that commanding scale, which the magnitude of the object demands.

MEMORANDA AND NOTES.

MEMORANDA.

MEMORANDUM I.—Page 12.

Mr. Maurice having informed his readers, that the Hindoos have, from the remotest periods of antiquity, been divided into four great tribes, adds, "The tribe of Brahmins alone are allowed to read and explain the Vedas or sacred books; and they explain them as they please to the other three tribes, who receive implicitly the interpretation of their priests. What an unbounded latitude this must open to imposition, in religious concerns, must be evident to every reader of reflection. It has arisen from this circumstance chiefly, that the pure and sublime theology of Brahma has been so debased and mutilated, especially on the coast of the peninsula, by the policy of a venal priesthood, that few of its original features are to be traced in the devotion of the common people, who are strangers to its genuine doctrines, and are enslaved by an everlasting round of ceremonies, not less painful than perplexing. The indefatigable exertions, indeed, of our own countrymen, have, of late years, burst asunder the veil that formerly obscured their religion, and the sacred language in the inscrutable recesses of which it was so long buried.

"How difficult it was, even in the time of the emperor

Akber, to penetrate behind that veil, will be evinced by the following interesting narrative.

"That prince, though bred in all the strictness of the Mahommedan faith, possessed a mind too liberal and enlarged to be holden in chains by any superstition whatsoever. With a design to choose his own religion, or, perhaps, from mere curiosity, he made minute inquiries concerning the several systems of divinity that prevailed among mankind. The letter of which Mr. Fraser has given to the world a translated copy*, in which he solicits the King of Portugal, that missionaries might be sent to instruct him, and his people in the doctrines of Christianity, is a singular instance of deviation, from the strong original bias to his own religion, in the mind of a Mahommedan. Akber was successful in his researches among all classes of religious votaries, except the Hindoos: from a knowledge of their sacred mysteries, he found himself excluded by a line which it was impossible to pass. Diametrically opposite to the Mahommedan and other systems of faith, which eagerly embrace proselytes of every description, the Brahmin superstition rejected all converts, and, consequently, defied all investigation. Not all his authority nor promises could induce the priests of that order to reveal the principles of their faith: at length, artifice succeeded where power failed; and, in Feizi, the brother of his minister and confident, Abul Fazil, a proper instrument seemed to be found to accomplish the desired object.

"Feizi was, at that time, but of tender years, but sufficiently advanced to receive instructions for the part he was to act. Under the character of a poor orphan of the sacerdotal tribe, he was received into the house, and under the protection, of a learned Brahmin at Benares, and, in the course of ten years, not only became master of the Sanscreet language, but of all the various branches of science taught at that celebrated university. The time approached for his return to the court of Akber, and measures for his safe and unsuspected departure from his patron, and the city where he had so long resided, were accordingly taken by the anxious monarch. An ardent passion, conceived by the youth for the beautiful daughter of the Brahmin, and the impulse of gratitude, strongly acting upon a generous mind, seduced him, in a moment, when virtuous principles predominated over the suggestions of vanity and ambition, to prostrate himself at the feet of his injured preceptor, to confess the intended fraud, and, amidst a flood of tears, to solicit his forgiveness.

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* See Fraser's Nadir Shah, p. 12, where that letter is given at length.

" The venerable priest, petrified with horror at the tidings, remained for some minutes in agonizing suspense and profound silence. At length, starting from his reverie, without descending to the bitterness of invective, he seized a poniard which hung at his girdle, and was just going to bury its point in his own bosom. The unhappy youth, arresting his uplifted arm, conjured him to attempt nothing against so sacred a life, and promised, cheerfully to submit to any severities that might expiate his offence. The Brahmin, who revered the uncommon genius and erudition of his pupil, now burst into tears, and declared his readiness to forgive him, as well as to continue in life, if he would grant him two requests. Feizi, with transport consented; and solemnly swore to hold his injunctions inviolably sacred. These injunctions were, that he should never translate the Vedas, nor reveal to any person whatever, the mysterious symbol of the Brahmin creed. Feizi kept the solemn promise he had made, as long as the Brahmin lived, but considered himself released from the obligation at the moment of his death. He then imparted to the secretary of Akber the leading principles of the Brahmin faith; which that writer detailed in the Ayeen Akbery; the first, though not the most ample, source of all the real knowledge we have obtained concerning the theology and literature of Hindostan."

Indian Antiquities, vol. iv. p. 24—28.

MEMORANDUM II.—Page 27.

		Chapter.	Ver.
When sun went down	Genesis,	xv.	17
The sun was risen	———	xix.	23
Sun was set	———	xxviii.	11
Sun arose	———	xxxii.	31
If the sun be risen	Exodus,	xxii.	3
Sun is down	Leviticus,	xxii.	7
Not sun go down	Deuteronomy,	xxiv.	15
Going down of the sun......	Joshua,	i.	4
Sun was down	———	viii.	29
Sun, stand thou still	———	x.	12
The sun stood still...........	———	—	13
Soon as the sun is up........	———	ix.	33
Sun went down...............	———	xiv.	18
The sun went down	2 Samuel,	ii.	24
Till the sun went down......	———	iii.	35

		Chapter.	Ver.
When sun riseth..............	2 Samuel,	xxiii.	4
The sun ariseth................	Psalm	civ.	22
Sun also ariseth, and the sun goeth down.........	Ecclesiastes,	i.	5
Sun, dial of	Isaiah,	xxxviii.	8
Sun shall no more go down	———	lx.	20
Sun stood still	Habakkuk,	iii.	11
Maketh his sun to rise on the evil	Matthew,	v.	45
Sun was up, they were scorched	———	xiii.	6
	Mark,	iv.	6
When sun was set they brought the sick.........	———	i.	32
Sun was setting............	Luke,	iv.	40
Sun is no sooner risen with a burning	James,	i.	11

Living beneath the splendour of a brighter day than that in which Tycho flourished, how obvious is it, that these, and similar expressions contained in the Bible, were used in conformity with the opinions of the times! The facts connected with these expressions, show that it was sufficiently difficult to teach the persons addressed, the science of morals, or the one more complex of theology, without adding to that, an attention to astronomical peculiarities. But, though at that period it would have been very inconsistent, and altogether subversive of the aim of the speaker, to have attended to these points, yet it is very satisfactory to find in these latter times, even this science lends its aid to show, that no rash or unguarded expression has crept within the four corners of that Book, which asserts itself to be our infallible guide.

There is a spotless temple rearing to Emmanuel's honour, and it is truly delightful to see the several builders actively employed, in doing what they can, to facilitate the progress of this lasting monument: and doubtless he, who, by a series of astronomical calculations, intends to evince, "that the standing still of the sun," "the retrogression of the shadow on the dial of Ahaz," and the "darkness at the crucifixion," agree with the testimony of ancient astronomers, is about to place one new stone on the costly edifice, rearing to Jehovah's praise.

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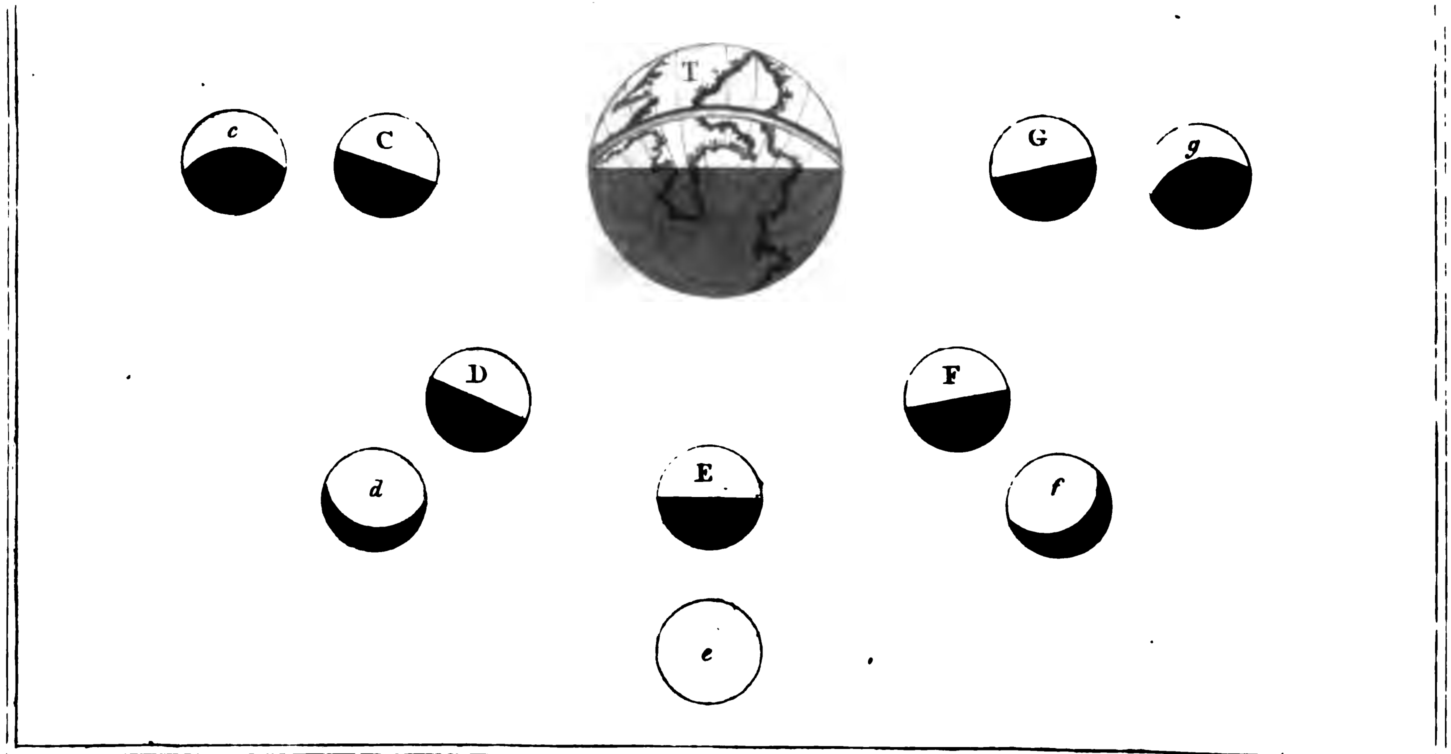
MEMORANDUM III.—Page 65.

One of the most remarkable circumstances attending the moon, is the continual change of figure to which she is subject: sometimes she appears perfectly full, or circular, at other times only half or a quarter illuminated, changing through a great variety of figures. And as these changes are always the same, at the same elongation from the sun, they prove that she receives her light from that luminary: for the moon being enlightened on that side only which faces the sun, a greater or less quantity of that enlightened part will be visible, according as it is turned towards us, or from us; and her figure will consequently appear to vary through the whole of her revolution. This may be easily illustrated by means of an ivory ball, which being held before the candle in various positions, will present a greater or less portion of its illuminated hemisphere to the view of the observer according to its situation.

The same thing may also be shewn thus: let S represent the sun, T the earth, and A, B, C, D, &c. the moon's orbit: then, when the moon is at A, in conjunc-



T. Wintwell delt

tion with the sun S, her dark side being entirely turned towards the earth, she will disappear, as at *a*, and is now called the new moon. When she comes to her first octant at B, or has gone through an eighth part of her orbit, a quarter of her enlightened hemisphere will be turned towards the earth, and she will then appear horned, as at *b*. When she is at *c*, or has gone through a quarter of her orbit, she shows one half of her enlightened hemisphere, as at C, and is then said to be a quarter old. At D, she is in her second octant, and by showing us more of her enlightened hemisphere than at *c*, she appears gibbous, as at *d*. At E, her whole enlightened side is turned towards the earth, and she now appears round, as at *e*, and is said to be at her full. In her third octant at F, part of her dark side being turned towards the earth, she again appears gibbous, and is on the decrease, as at *f*. At G, we see just one half of her enlightened side, at which time she appears still farther decreased, as at *g*. When she comes to her fourth octant at H, we only see a quarter of her enlightened hemisphere, which occasions her to appear horned, as at *h*. And at A, having now completed her course, she again disappears, or becomes a new moon as before.

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MEMORANDUM.—Page 167.

When the conversation on the method of finding the stars was written, and, indeed, till 250 pages of the volume were printed, I intended only to present two or three detached constellations. But, the decided expressions of approbation the map now introduced has received, have led me to deviate from my original intention. This deviation will account for the use of some words in this dialogue, which now appear to be injudiciously applied.

As two representations of Ursa Major are now given, it seemed desirable that the second should not be below the pole, that to young persons, some idea of the revolution of the stars around a fixed point might be brought before their view. To save the pupil's time in copying this little production, I add, that Q in Canis Major is the centre of the circle, the arc of which passes from h in Ursa Minor, to Coma Berenices. R, The only star of importance in Camelopardalis, and, consequently, the only one introduced into the map, in the centre of a circle, the arc of which extends from Coma Berenices, to Cygnus.

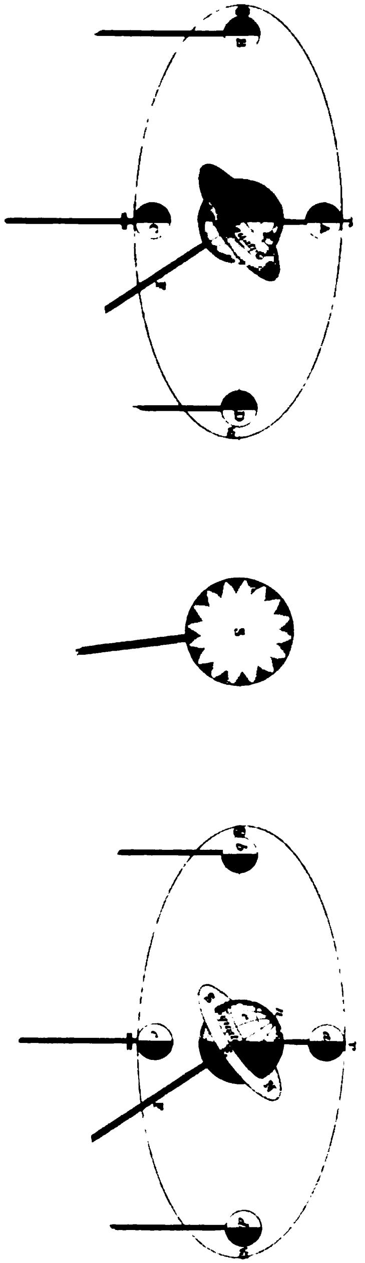
S, in Orion, is the centre of a circle, the arc of which extends from the Pole Star, to Cor Hydræ.

T, in Hercules, is the centre of a circle, the arc of which extends from the Pleiades, to Markab.

V, in Serpens, is the centre of a circle, the arc of which extends from Castor, to Algenib.

MEMORANDUM IV.—Page 73.

A VIEW of this figure will render what has been said in the body of the work obvious. Let S be the sun, *e* the earth in summer, when its north pole *n* inclines towards the sun, and E the earth in winter, when its north pole declines from him. S E N and N W S is



C.V. Whitwell del.t

J. Cross sculp.t

the horizon of the north pole, which is co-incident with the equator; and in both these positions of the earth, ♈ ♋ ♎ ♑ is the moon's orbit, in which she goes round the earth, according to the letters *a b c d*, A B C D. When the moon is at *a*, she is in her third quarter to the earth at *e*, and just rising to the north pole *n*; at *b* she changes, and is at the greatest height above the horizon, as the sun likewise is; at *c* she is in her first quarter, setting below the horizon; and is lowest of all under it at *d* when opposite to the sun, and her enlightened side towards the earth. Thus, in our summer, the moon is above the horizon of the north pole while she describes the northern half of the ecliptic ♈ ♎ ♋, or from her third quarter to her first; and below the horizon during her progress through the southern half ♎ ♑ ♈; highest at the change, most depressed at the full. But in winter, when the earth is at E, and its north pole declines from the sun, the new moon at D is at her greatest depression below the horizon N W S, and the full moon at B at her greatest height above it; rising at her first quarter A, and keeping above the horizon till she comes to her third quarter C. At a mean state she is 23½ degrees above the horizon at B and *b*, and as much below it at D and *d*, equal to the inclination of the earth's axis F. S ♋ or S ♑ are, as it were, a ray of light proceeding from the sun to the earth; and shows that when the earth is at *e*, the sun is above the horizon, vertical to the tropic of Cancer; and when the earth is at E, he is below the horizon, vertical to the tropic of Capricorn.

This extract, with the accompanying illustration, from Ferguson's Astronomy, p. 223.

MEMORANDUM.—Page 75.

Suppose a spectator at *a* sees the moon in the horizon at B; he will see her under the angle *c a b;* because the ray from her upper limb *d o*, will be so refracted by the earth's atmosphere at *o*, as to be bent into the direction *o a;* and as we see every thing along that line in which the rays come to us last, we see the upper limb of the moon *d* along the line *a c*, and, of course, greatly magnified. But when she arrives more in the zenith, or at the meridian A, the rays are not so much refracted as when they fall more obliquely on the atmosphere; therefore she appears near her natural size. The moisture and vapours generally over our island contribute to this deception.

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MEMORANDUM VI.—Page 113.

The Length of the Year of the four newly-discovered Planets.

	Years.	Days.	Hours.	Minutes.	Seconds.
Ceres	4	221	12	56	9
Pallas.........	4	221	17	0	57
Juno	4	130	23	57	7
Vesta	3	240	4	55	12

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MEMORANDUM VII.—Page 115.

When we reflect upon the diminutive stature of man, bearing a less proportion to the bulk of the earth, than the smallest microscopic insect does to the plant on which it lives, we must be surprised at the portion of astronomical information he possesses. Still there are a multitude of problems he cannot solve; to reason from analogy is in many cases the utmost he can do. There was a period, in which this mode of reasoning was of considerable consequence in establishing the figure, and the motion, of the earth. It is not now without it uses in judging of the atmosphere of the moon. It is, therefore, exceedingly satisfactory to the inquiring mind, to trace a resemblance in the laws, which govern sublunary, and celestial, bodies. Nothing is more obvious, than that the multiplied moons to the distant planets, are a compensatory contrivance. Our present inquiry is, Is there any thing of the same kind evinced in the more minute operations of nature? Dr. Paley has favoured the public with a distinct chapter in his Natural Theology on this subject; to that I must refer the reader for a more ample elucidation of the point. In the interval, he may not be displeased with this concise illustration. The large head of the elephant rendered it necessary, that it should not be detached from the body by a long neck. But with a neck so short and inflexible, and head so large, upon a body of such an elevation, how was it to be supplied with the means of nutrition? We receive an answer, when we observe the length and flexibility of his proboscis.

The bat can neither run upon its feet, nor raise itself from the ground by their means. What is to be done? It appears likely that it should be the most helpless of animals. To prevent this, the Creator has deviated from the arrangement observed in the wings of other birds, and has placed a bent claw in its wings, so that it can hook itself to any thing on which it wishes to alight.

"The upper bill of the parrot is so much hooked, and so much overlaps the lower, that if, as in other birds, the lower chap alone had motion, the bird could scarcely gape wide enough to receive its food: yet this hook and overlapping of the bill could not be spared, for it forms the very instrument, by which the bird climbs; to say nothing of the use which it makes of it in breaking nuts and hard substances, upon which it feeds. How, therefore, has nature provided for the opening of this secluded mouth? by making the upper chap moveable as well as the lower. In most birds, the upper chap is connected, and makes but one piece with the skull; but in the parrot, the upper chap is joined to the bone of the head by a strong membrane, placed on each side of it, which lifts and depresses it at pleasure."

"The spider's web is a compensating contrivance. The spider lives upon flies, without wings to pursue them; a case, one would have thought, of great difficulty, yet provided for, and provided for by a resource, which no stratagem, no effort of the animal could have provided, had not both its external and internal structure been specifically adapted to the operation."

"Some say, that in the origin of things,
When all creation started into birth,
The infant elements receiv'd a law,
From which they swerve not since: that under force
Of that controlling ordinance they move,
And need not His immediate hand, who first
Prescrib'd their course, to regulate it now.
Thus dream they, and contrive to save a God
Th' incumbrance of his own concerns, and spare

The great Artificer of all that moves
The stress of a continual act, the pain
Of unremitted vigilance and care,
As too laborious and severe a task.
So man, the moth, is not afraid, it seems,
To span omnipotence, and measure might,
That knows no measure, by the scanty rule
And standard of his own, that is to-day,
And is not ere to-morrow's sun go down.
But how should matter occupy a charge,
Dull as it is, and satisfy a law
So vast in its demands, unless impell'd
To ceaseless service by a ceaseless force,
And under pressure of some conscious cause?
The Lord of all, himself through all diffus'd,
Sustains, and is the life of all that lives.
Nature is but a name for an effect,
Whose cause is God. He feeds the secret fire,
By which the mighty process is maintain'd,
Who sleeps not, is not weary; in whose sight
Slow circling ages are as transient days;
Whose work is without labour; whose designs
No flaw deforms, no difficulty thwarts;
And whose beneficence no charge exhausts.
Him blind antiquity profan'd, not serv'd,
With self-taught rites, and under various names,
Female and male, Pomona, Pales, Pan,
And Flora and Vertumnus; peopling earth
With tutelary goddesses and gods,
That were not; and commending as they would
To each some province, garden, field, or grove.
But all are under one—one spirit—His,
Who wore the platted thorns with bleeding brows,
Rules universal nature. Not a flow'r
But shows some touch, in freckle, streak, or stain,
Of his unrivall'd pencil. He inspires

Their balmy odours, and imparts their hues,
And bathes their eyes with nectar, and includes,
In grains as countless as the sea-side sands,
The forms, with which he sprinkles all the earth.
Happy who walks with him! who what he finds,
Of flavour, or of scent, in fruit, or flow'r,
Or what he views of beautiful, or grand
In nature, from the broad majestic oak
To the green blade, that twinkles in the sun,
Prompts with remembrance of a present God.
His presence, who made all so fair, perceiv'd
Makes all still fairer."

MEMORANDUM VIII.—Page 187.

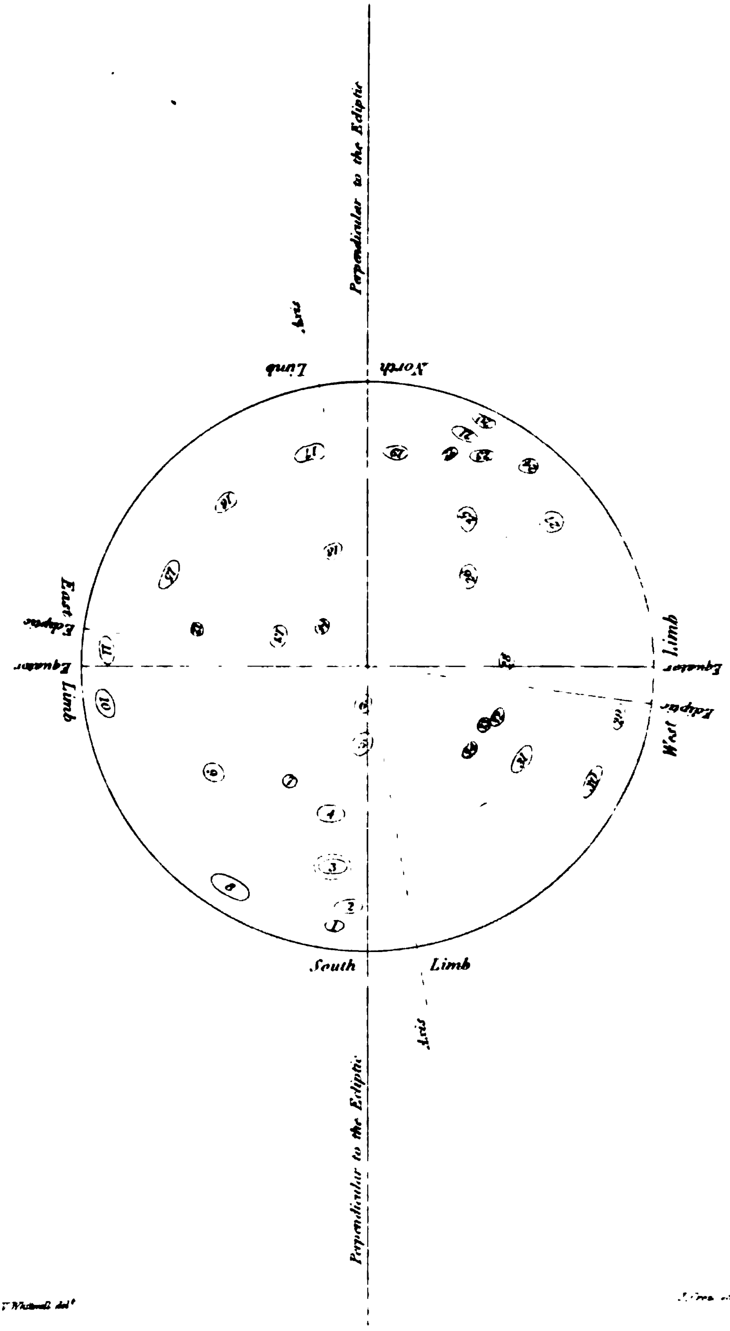
"Among the astronomers of Chaldea, Nimrod was known by the names of Orion and Belus. The Phœnicians conferred on him a title implying somewhat more than Bel or Belus, and meaning the sun in that full meridian strength, in which he attacked and overcame the Nemæan Lion."

Maurice's History of Hindostan, vol. ii. p. 28.

MEMORANDUM IX.—Page 46.

Sun's diameter	32′	35″	6	Greatest.
....	31	31	0	Least.
....	32	3	3	Mean.
		8″	¼	Parallax.

The sun's spots appear to describe right lines about the latter end of November, and the beginning of December, and at the beginning of June, and the end of May, as in Fig. 2.



T. Whitwell del.

[illegible]

From June to December, their path appears as in Fig. 1; and from December to June, as in Fig. 3.

In the year 1779, Sir William Herschel measured a spot, and found it 50,000 miles in diameter, or more than six times the diameter of our earth.

Sun's diameter 111.454
...... volume 1384472 } That of the earth being 1.
...... mass 337086
...... density ¼ of the earth's.
...... spots revolve in 27 D. 7 H. 37 M.
...... sidereal revolution, 25½ days.
One pound on the earth would weigh 27.938.

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MEMORANDUM X.—Page 63.

The Lunar Nomenclature of Ricciolus.

1. Blancanus.
2. Clarius.
3. Tycho.
4. Pilatus.
5. Arzachel.
6. Ptolemæus.
7. Bullialitus.
8. Schickhardus.
9. Gassendus.
10. Grimaldus.
11. Hevelius.
12. Keplerus.
13. Copernicus.
14. Eratosthenes.
15. Aristarchus.
16. Heraclides.
17. Plato.
18. Archimedes.
19. Aristoteles.
20. Zoroaster.
21. Endymion.
22. Hercules.
23. Atlas.
24. Mercurius.
25. Possidonius.
26. Menelaus.
27. Cleomedes.
28. Censorinus.
29. Langrenus.
30. Petavius.
31. Fracastorius.
32. Theophilus.
33. Cyrillus.
34. Catherine.

MEMORANDUM XI.—Page 197.

These mansions of the moon are marked on the celestial globes made and sold by Mr. G. Adams, Waterloo Place.

MEMORANDUM XII.—Page 234.

Hesperus was the son of Atlas, a regal astronomer, who reigned in the west of Africa, and brother of the Atlantides, or Pleiades.

MEMORANDUM.—Page 145.

Dr. Halley conceived the whole solar system, together with all the systems of the stars, to be in motion round some point, which is the centre of gravity of the whole; and, in pursuing this idea, the following reflections naturally occurred to him: "If the number of stars be finite, and occupy only a part of space, it will follow, that they must be surrounded by a void. But as this void can have no action upon the bodies which it environs, those bodies must exert all their force upon each other without equilibrium, and without compensation.—Those which are at the extremities, or near the borders of the void, will be strongly and continually attracted by those near the centre; and these efforts continued and multiplied through a number of ages, must, at length, draw all the suns and planets into that point, and form one immense mass, which must for ever remain there without action and without motion. But if, on the contrary, the number of stars be infinite, and the systems without bounds, all the forces will be balanced among themselves; the suns and planets will preserve the paths prescribed them, and the order of the universe will be perpetually the same."

MEMORANDUM XIII.—Page 297.

An assemblage of thirty-one stars to the south-east of Orion, is known by the general term of Canis Major; while Sirius is confined to the bright star in the Dog's mouth. For a more extended use of the term Sirius, I am sanctioned by Mr. Maurice, who says, "Admitting, upon the strong evidence adduced by Mr. Bruce, the identity of Osiris and Sirius, I must contend for applying the former name Osiris, to the whole constellation, and the name of Anubis to that resplendent star which astronomers observe to be in the mouth of the Dog, and which may more properly be called the Dog Star. In fact, on the old Egyptian sphere, the Canis Major is designated exactly like the figure of Anubis, which they publicly exhibited on the approach of the inundation, that of a human figure with a dog's head placed upon its shoulders *."

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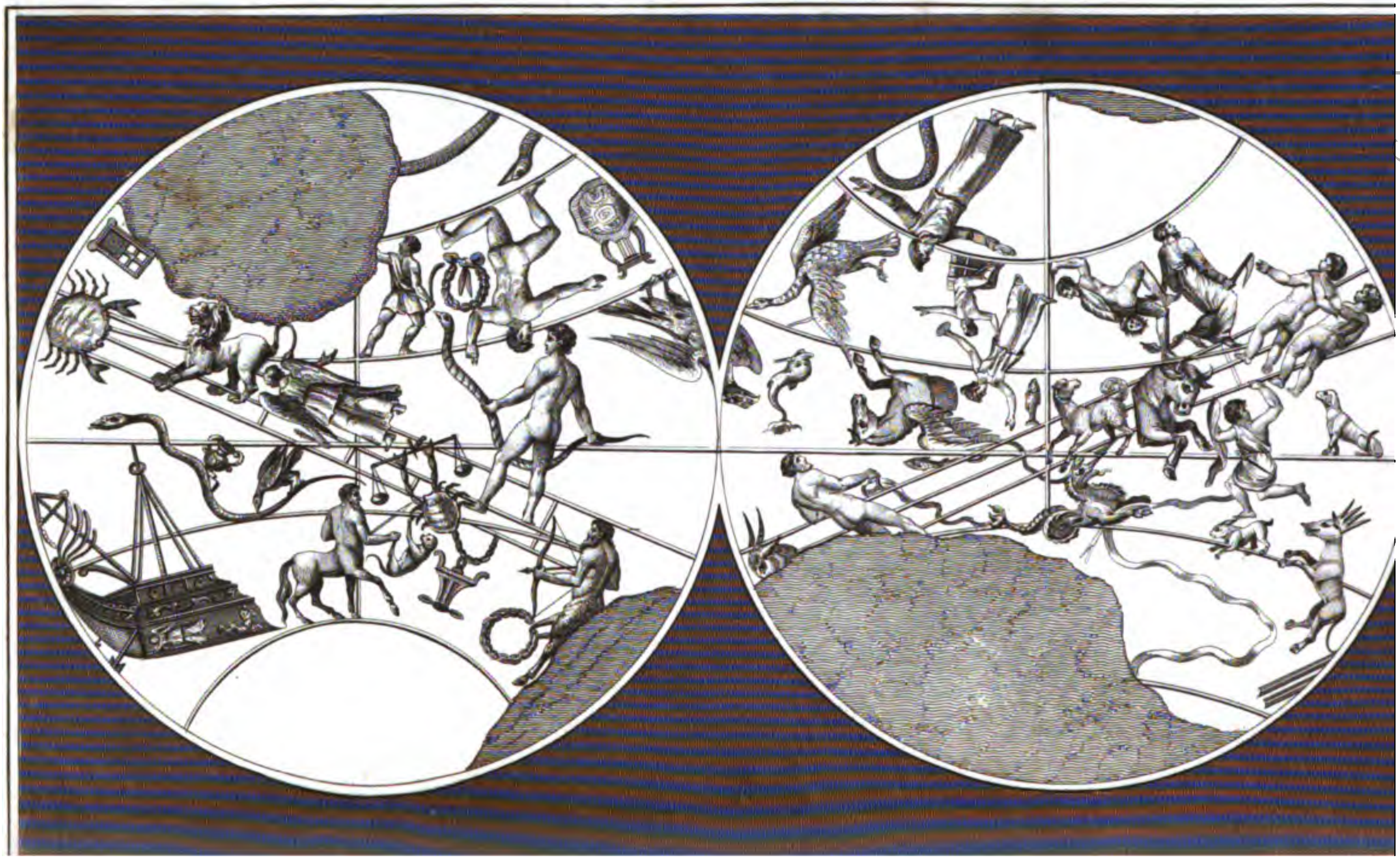
* History of Hindostan, vol. i. p. 189.

MEMORANDUM XV.—Page 307.

Ancient Constellations, their probable Origin and Import, with the Grecian Appropriation.

Names of Constellations.	Their probable Origin and Import.	Grecian Appropriation.
Aries.	Chaldean, Ram. Egyptian, Jupiter Hammon.	The Ram from which Jason obtained the fleece, brilliant as gold.
Taurus.	Chaldean, Bull. Egyptian, Apis, Osiris.	The Bull, containing the Pleiades and Hyades, daughters of Atlas.
Gemini.	Chaldean and Persian, two Kids. Egyptian, Hercules and Apollo.	Castor and Pollux.
Cancer.	The Egyptian Taut.	The Sea-crab sent to annoy Hercules.
Leo.	Egyptian symbol of solar heat.	The Nemæan Lion.
Virgo.	Noah's Consort. The Babylonian Venus. Egyptian Isis.	The Grecian Astræa.
Libra.	An Egyptian utensil employed in measuring the waters of the Nile.	The Scales of Astræa.
Scorpio.	The Egyptian Typhon, the enemy of Osiris.	The Scorpion that stung Orion.
Sagittarius.	The Armour-bearer of Osiris, darting his arrows at the Scorpion; the origin of the fable of Apollo, shooting his thousand darts on the serpent Typhon.	
Capricornus.	An Egyptian compound, expressive of the course of the sun and of descending rains.	The Goat which climbs mountains, an emblem of the ascent of the sun.
Aquarius.	Chaldean general Deluge. Egyptian Nile.	Ganymede, Cupbearer to the Gods.
Pisces.	Among the Chaldeans, Egyptians, and Hindoos, half a human and half a bestial form. Noah.	Venus and her son.
Ursa Minor.	Phœnician, the little Wagon.	The residence of the son of Diana's nymph Callistho.
Ursa Major.	Chaldean, the Wagon called by the Hindoos the Great Constellation.	Callistho.



Draco.	Egyptian, the old Serpent.	The Dragon of the Hesperides.
Auriga.	Probably allusive to the Comet which occasioned the deluge, and the origin of the fable of Phaëton.	The Charioteer.
Perseus.	Chaldean.	The Combatant with the three Gorgons.
Cepheus.	Egyptian. Egypt.	King of Ethiopia and one of the Argonauts.
Cassiopeia.	Egyptian. Perseverance contending with the inundation of the Nile.	The wife of Cepheus.
Andromeda.	Egyptian. The Nile, beautiful when bound.	The daughter of Cepheus and Cassiopeia.
Cygnus.	- -	One of the forms assumed by Jupiter.
Serpentarius and Serpens.	Egyptian. The old Serpent, and He who should curb his power.	Esculapius, and one of the tribe formerly used in medicine.
Hercules.	Phœnician. The Deliverer. Nimrod.	The great hero of antiquity executing twelve wonders.
Sagitta.	The Arrow of Hercules.	
Aquila.	- -	Merops, King of Cos.
Antinous.	- -	A favourite of the Emperor Adrian.
Delphinus.	Egyptian. Thus honoured for great service to Neptune.	
Lyra.	The Harp of Jubal—of the Indian Apollo.	Of the Greek Orpheus.
Coma Berenices.	Egyptian. The Hair of Berenice, wife of Ptolemy.	
Equulus.	A young Horse both on the Hindoo and Grecian spheres.	
Pegasus.	Chaldean. The fall of Adam.	The fall of Bellerophon.
Triangle.	Egyptian. The △ Delta of the Nile.	
Boötes.	Chaldean. Noah.	Boötes.
Corona Australis.	The Crown of Noah's armour-bearer.	A wreath round the leg of Sagittarius.
Centaurus.	Chaldean. Noah.	Chiron, the son of Saturn.
Lupus.	Chaldean. The beast sacrificed.	The Wolf.
Ara.	Chaldean. Noah's Altar.	Altar of Cyclops on which the Gods swore.
Argo.	Phœnician. Noah's Ark. Canopus Japhet. Also the Egyptian God of Mariners.	Argo Navis. Canopus, the Greek Neptune.

Table of ancient Constellations—continued.

Names of Constellations.	Their probable Origin and Import.	Grecian Appropriation.
Hydra.	The Flood. Egyptian, the Nile.	The hundred-headed Monster in the lake Lerna.
Corvus.	Egyptian. Noah's Raven. The Pleiades, Noah's Dove.	The Crow of Apollo.
Crater.	Egyptian. Noah's Vase.	The Bowl of Bacchus.
Eridanus.	Chaldean. The asterism of the river. The river of Nimrod or Orion.	The Po in Italy.
Orion.	Chaldean. Nimrod.	The gift of Jupiter, Neptune, and Mercury, to Hircus.
Lepus.	Chaldean. The Hare, illustrative of the character of Nimrod and of Orion.	
Canis Major.	The Great Dog of Nimrod. To the Egyptians a symbol of Sirius the Dog Star, the celestial barker. The consort of Noah has a residence in the Dog's head.	One of Orion's hounds.
Canis Minor.	The forerunner of the greater Dog.	Another of Orion's hounds.
Cetus.	Egyptian. The unexpected inundations of the Nile.	The Monster to devour Andromeda.
Piscis Australis.	Probably some reference to the deluge.	The form Venus took to escape the fury of Typhon.
Sun.	Noah. Among the ancient Persians, Shem had this honourable station assigned him.	
Moon.	The Ark.	
Saturn.	Noah.	
Jupiter.	Ham, the son of Noah, the Jupiter Hammon of antiquity, the founder of the Egyptian nation.	
Mars.	Nimrod.	
Venus.	Semiramis.	
Mercury.	Phuth, the third son of Ham.	

The Constellations introduced by Hevelius.

	Hevelius.	Flamstead.
Lynx	19	44
Leo Minor. Little Lion		53
Asterion and Chara. Greyhounds	23	25
Cerberus	4	
Vulpecula et Anser. Fox and Goose	27	35
Scutum Sobieski. Sobieski's Shield.	7	
Lacerta. Lizard	10	16
Camelopardalis. Camelopard	32	58
Monoceros. Unicorn	19	31
Sextans. Sextant	11	41

NOTES.

NOTE I.—Page 315.

That this remark may be understood in its largest latitude, and receive that attention which its importance demands; I observe, that some animals, on which the experiment has been made, have lived without the spleen for some time; still this does not prove it was an unnecessary addition, since it acts as a cushion to fill up a ventricle, which, unless it was occupied, would leave the parts adjoining, loose, and unsteady.

NOTE II.—Page 338.

Should it be observed, that the births of such men, as Cyrus, Alexander, and Augustus, are to be ranked among the natural occurrences of every day; I answer, that the very terms, ordinary occurrences and laws of nature, imply the direction of a great law-maker; and, that, because laws act uniformly, it is most inaccurate to judge, that there is not a Being who makes, and regulates the developement of, these laws. Truly, it was a natural circumstance, that Cyrus should be born; but, in tracing the developement of God's plans, it is interesting to see, that "Xenophon himself, who wrote his history, never exhibited him as an invincible hero in stronger terms than Isaiah. He was to come flushed with conquest to the subjugation of a vast city; and from vanquished nations, he was to go up against an empire which had forged chains for all its neighbours. Accordingly, Xenophon enumerates fourteen nations which he either subdued by the force of arms, or which submitted to him, and over which he reigned, besides Babylon. 'Thus saith the Lord to his anointed, to Cyrus, whose right hand I have holden to subdue nations.' And without any great exaggeration to increase the pomp of his style, at the head of his decree in favour of the Jews, he writes, 'Thus saith Cyrus, king of Persia, The Lord God of heaven hath given me all the kingdoms of the earth.'"

It must be admitted, that the prediction is sufficiently clear, respecting the principal instrument: it was no less so respecting those which were subordinate. It was not to be subdued by Medes alone, neither by Persians alone, but both these were to form the destroying army, under one leader. The command was, "Go up, O Elam," the ancient name of Persia; "Besiege, O Media." Cyrus, as king of the Persians, employed his own forces; and the Medes were consigned to his command in this expedition by their monarch, to whom he was related, by double ties of consanguinity.

The time was determined and described with the same accuracy. It was to take place by night, "a night of festivity, a night of riot and of intemperance."

And the more minutely we examine the pages of history, the more satisfactorily shall we see the developement of both these laws; namely, that events transpire according to *natural or uniform laws*, but that these laws in all their applications are agreeable to the appointment of Infinite Wisdom. Thus, the artful policy and the superior force of Philip rendered his ascendency over the rest of Greece a natural result; it as naturally followed, that he should be chosen generalissimo of the confederated Greeks against the Persians. His son, conscious of his mental resources, flew in his career like an eagle. He crossed the Hellespont, visited Ilium, subdued Asia Minor, conquered Syria, exterminated the Tyrians, marched into Egypt, built Alexandria, traversed the northern Asia, crossed Paropamisus, conquered the nations to the west of the Indus, and subdued western India itself.

All this we properly ascribe to his ambition, but improperly forget that this was productive of beneficial results to mankind.

It would surely have been quite as natural, that the result should have been detrimental, and infinitely more natural, than that it should have been the means of preparing the way for receiving information of the advent of our Lord Jesus Christ.

In perusing the annals of the Roman history, the kingly authority yields naturally to the consular government, and this as unavoidably bows before him who was vested with the imperial purple. The seven first centuries of the existence of this empire were filled with a rapid succession of triumphs; but Augustus, "inclined to peace by his temper and situation, discovered that Rome, in her present exalted situation, had much less to hope than to fear from the chance of arms; the undertaking became every day more difficult, the event more doubtful, and the possessions more precarious and less beneficial. The experience of Augustus added weight to these salutary reflections, and effectually convinced him, that by the prudent vigour of his counsels, it would be easy to secure every concession, which the safety or the dignity of Rome might require from the formidable barbarians *." Such is the testimony of Mr. Gibbon, an author, I presume, not to be condemned for his attachment to the cause I plead. Well may I ask, why did so rare a character exist at all? but why did this consummate politician live at this moment? why did *he* become sole master of the Roman world? why not Marc Antony or Lepidus? why did he *now* succeed in a project, which, at an earlier period of the Roman empire, would have cost him his life, and so dexterously, that monarchy was not during his life oppressive; but he, who had dared to new-model the state, was as a god worshipped after his decease? How was it, that, after seven centuries, just at this needed moment, universal peace was established? How was it, that, after the calamities which exhibited themselves from the time of Marius, which were filled with recitals of sanguinary proscriptions, and crowded with images of martial horror, that peace, and happiness, and order, should be restored? How was it, that, just at this moment, a man should arise, who preferred the use, to the abuse of power, on whom the smiles of fortune acted so marvellously, that they turned the sanguinary tyrant into a mild and generous prince?

All this was subservient to the consummation of the work, commenced by Alexander. He had built cities, introduced wholesome laws, and had instituted the means of communication with the most distant provinces, so that they could be apprised of every occurrence of interest, that transpired in the known world; among the rest, of the incarnation of man's Restorer to bliss. And it is not simply to be considered a natural occurrence, but also as a designed and merciful selection by the Deity, that He, who was to come, chose not the confines of Alexander's conquests for his abode, but the spot as nearly as possible central between Macedon and India. But the evil disposition of man, for ever at variance with the benevolent plans of the Deity, creating wars, shattered the kingdom consolidated by Alexander, and thus it continued till this mighty empire was swallowed up by the surpassing majesty of Rome. Then, again, a free intercourse existed all over the world; and, lest any barrier should present itself, to oppose the knowledge of the Saviour's birth, a period of universal peace was selected for his coming; as an evidence of which the bloody portal of war was shut, the gates of the temple of Janus were closed. But still the descendant of David, from whom our Redeemer sprang, was in obscurity. What shall draw her thence? Shall he, before whom tributary kings cast their crowns, think of her? no; but in the gratification of his ambition, the end shall be secured. All heaven is on the move to make way for the descent of the Son of Righteousness. Earth feels the impulse, Augustus sends forth the decree, that all the world shall be taxed; but though the movement is made, a few more rising, a few more setting suns must intervene! But Augustus has made the decree! What can be done? The world is to be taxed, all the names are to be registered, and the names of Joseph and Mary not be recorded there! Something perfectly natural must intervene. Yes, there is time! one more bloody war may be commenced, and be closed; the Germans may issue from their forests, and from their morasses, and yet the gates of Janus be shut, when the Prince of Peace shall appear. Yes; Augustus shall lose a Varus and his three legions; he shall be reminded of the vicissitudes of fortune; seven and twenty years shall roll by, and *then*, in the republication of the decree, the pride of Augustus shall be gratified, and the ends of heaven shall be answered. Thus do natural occurrences evidently fall under some grand general law of Infinite Wisdom, though with those laws we are unacquainted.

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* Decline and Fall of the Roman Empire, vol. i. page 2.

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NOTE III.—Page 341.

I SHALL present to the reader two specimens of the character which the age of chivalry furnishes: the first, of Edward the Black Prince; the second, of Sir Philip Sidney. Mr. Hume says, of the former, "Soon after the glorious battle of Poictiers in 1356, he landed at Southwark, and was met by a great concourse of people of all ranks and stations. His prisoner, John, king of France, was clad in royal apparel, and mounted on a white steed, distinguished by its size and beauty, and by the richness of its furniture. The conqueror rode by his side in meaner attire, and carried by a black palfrey. In this situation, more glorious than all the insolent parade of a Roman triumph, he passed through the streets of London, and presented the king of France to his father, who received him with the same courtesy, as if he had been a neighbouring potentate that had voluntarily come to pay him a friendly visit. It is impossible, on reflecting on this noble conduct, not to perceive the advantages which resulted from the otherwise whimsical principles of chivalry, and which gave, even in those rude times, some superiority even over people of a more cultivated age and nation *."

Mr. Kett has thus epitomized the character of the latter individual: "Sir Philip Sidney, descended from John Dudley, Duke of Northumberland, by the mother's side, was born at Penshurst in Kent in 1554, and died at the age of 32. During his education at Shrewsbury and Oxford, he made an astonishing proficiency in all branches of learning. His conduct was, upon all occasions, such as to do honour to a true knight. He could not brook the least affront, even from persons of the highest rank, as he proved by his spirited behaviour to the haughty Earl of Oxford, a nobleman very high in the favour of Queen Elizabeth.

"This quarrel occasioned his retirement from court, during which he wrote his romance called Arcadia, which he dedicated to his sister, the Countess of Pembroke. At the grand tournament held in 1581, for the entertainment of the Duke of Anjou, when he came to London to solicit the Queen in marriage, Sir Philip went through his feats of arms with great ability, and gained singular commendation. Such was his fame for relieving all who were in distress, that when the Spaniards had seized the kingdom of Portugal, Don Antonio, the chief competitor for the crown, applied to him for his assistance. He was appointed governor of Flushing, one of the towns delivered by the Dutch to the Queen, and in several

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* Hume, vol. iii. p. 460.

actions with the enemy, behaved with extraordinary courage, and with such mature judgment, as would have done credit to the most experienced commanders. His high renown and great deserts were so well known throughout Europe, that he was put in nomination for the crown of Poland upon the death of Stephen Batori; but the Queen refused to further his promotion. On the 22d of September 1586, being sent out to intercept a convoy that was advancing to Zutphen, he fell into an ambuscade, and received a fatal wound in the thigh. In his sad progress from the field of battle, passing by the rest of the army, where his uncle, Robert Earl of Leicester was, and being thirsty with excessive loss of blood, he called for drink, which was soon brought him: but, as he was putting the bottle to his mouth, he saw a poor soldier carried along who had been wounded at the same time, eagerly fixing his eyes upon it. As soon as Sir Philip perceived his inclination, he delivered the bottle to him with these words—'Thy necessity is greater than mine.' This action discovered a disposition so tender, a mind so fortified against pain, a heart so overflowing with generosity to relieve distress, in opposition to the most urgent call of his own necessities, that none can read a detail of it without the highest admiration. Finding himself past all hope of recovery, he prepared for death with the greatest composure, and assembled the clergymen of divers nations, before whom he made a full confession of his Christian faith. The closing scene of his life was the parting with his brother Sir Robert Sidney, of whom he took leave in these words: 'Love my memory, cherish my friends; their faith to me may assure you they are sincere: but, above all, govern your will and affections by the will and word of your Creator, in me beholding the end of the world, with all her vanities.' As he had been, during his life, beloved, admired, and almost idolized by all ranks of men, so was his death most deeply lamented. He was the fairest flower of chivalry, the bright jewel of an illustrious court, and a pattern of superior excellence, even in an age of heroes*."

Nor let it for a moment be forgotten, that every nation, and every age, has presented those, who have most appropriately borne the honourable, but abused, name of Christian. Let any one attentively read Dean Milner's Church History, and doubt respecting the accuracy of this statement will not remain on his mind. The character of the Christian missionary, as portrayed by the Bishop of Worcester, may not be here improperly introduced. He is speaking of charity, when he adds, "Indeed, the difficulties, the dangers, the distresses, of all sorts, which must be encountered by the Christian missionary, require a more than ordinary degree of that virtue, and will only be sustained by him, whom a fervent love of Christ, and the quickening graces of his Spirit, have anointed, as it were, and consecrated to this arduous service. Then it is that we have seen the faithful minister of the word go forth with the zeal of an apostle, aud the constancy of a martyr. We have seen him forsake ease and affluence, a competency, at least, and the ordinary comforts of society; and with the Gospel in his hand, and his Saviour in his heart, make his way through burning deserts and the howling wilderness, braving the change of climates, and all the inconveniences of long and perilous voyages; submitting to the drudgery of learning barbarous languages, and to the disgust of complying with barbarous manners; watching the dark suspicions, and exposed to the capricious fury of savages; courting their offensive society, adopting their loathsome customs, and assimilating his very nature, almost to theirs; in a word, 'enduring all things, becoming all things,' in the patient hope of finding the way to their good opinion, and of succeeding finally, in his unwearied endeavours to make the word of life and salvation not unacceptable to them. I confess, when I reflect on all these things, I humble myself before such heroic virtue: or rather, I adore the grace of God in Jesus Christ, which is able to produce such examples of it, in our degenerate world."

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* Lord Lyttelton's Life of Henry the Second, vol. iii. p. 54. Biographia Britannica, article Sidney, &c.

Could the Bishop thus have spoken, if the world had not presented heroic worthies, which nothing short of the Christian religion could have furnished?

Read of the patience and the tenderness, the zeal and the wisdom of a Ziegenbalg, a Swartz, a Gerické, an Eliot, a Brainerd, a Buchanan; and say, if, while it reproves the low standard of piety prevalent among us, it does not also evince, what will be the result of the general diffusion of this knowledge among the rising generation?

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NOTE IV.—Page 342.

That the religion of the blessed Jesus has not taken the sweep of a larger circle, seems but in unison with the majestic march of our God, throughout all the steps of man's restoration to bliss; and from this we may argue, how malignant is the offence, and how deep is the wound of man's rebellion. Nearly two thousand years * revolved, with only one reviving promise, on which expectation could repose; and during that interval the deluge descended, which swept the descendants of the first transgressors from the earth. More than nine additional centuries † revolved, before a copious supply of prophecies imparted an idea of the nature, the character, or the offices, of the Redeemer. Four more centuries slowly crept away, before Isaiah's harp struck its melodious accents. And when the last blast of the prophetic trumpet was blown, did our Restorer to bliss immediately appear? No—four hundred years elapsed, and not one ray of light gilded the dark horizon.

Those best acquainted with the history of the church, and of the world, know, that, though society has not yet allowed the full developement of the benign and heavenly influences of the Christian religion, it has at least sufficiently operated to show, that a grand scheme is carrying on, the parts of which have a mutual reference, the one to the other.

The Christian religion has triumphed over those practices, customs, and institutions, which, before its light arose, darkened the character of man. It has softened the horrors of war, and has alleviated the treatment of prisoners. The severe and marked degradation, stamped on the tender sex, because "Eve was first in the transgression," is removed by virtue of the Redeemer, who has appeared to restore her to pristine purity; and

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* From the fall to the time of Abraham.

† From Abraham to David.

that religion, which thus smiles upon her, shelters her offspring by abolishing the cruel practice of exposing infants. It has put a stop to the combat of gladiators, the favourite and barbarous amusement of the Romans. It has banished the impure customs, that disgraced the worship of the pagan deities, as well as totally extinguished the worship itself. It has abridged the labours of the mass of mankind, and procured for them one happy day in seven for the enjoyment of repose, and attention to the exercises of public devotion. It has occasioned establishments for the relief of sickness and poverty, and the maintenance of helpless infancy and decrepit old age.

It has triumphed over the slavery, that prevailed in every part of the Roman empire, and pursues its glorious progress in the diminution of misery and oppression throughout the world.

In Hindostan, the native begins to be ashamed of his superstition, and the mild influences of the Christian religion, shine on the temple of Mecca.

In Persia also, and in China, the knowledge of the Bible is spreading. In Ceylon, and Travancore, in New Holland, in New Zealand, and in Africa, Christian teachers are encouraged. And it is well known, how long and how sincerely the Christian religion has shed its benign and heavenly influence in America. Those, who are dissatisfied, or astonished at the slow progress of pure and vital Christianity, certainly take a partial view of the operations of the Deity. As there is space enough in creation for the developement of that grand exhibition of creative energy, which it has been one object of this work to present to the youthful mind; so there is time enough in duration, for the developement of that glorious plan which the Bible exhibits to our view. Therefore, on the one hand, I would urge to increasing activity, and, on the other, I would supplicate a patient surrender of our opinions, to the superior views and plans of the Deity.

THE END.

S. Gosnell, Printer, Little Queen Street, London.

ERRATA.

Page 114, line 24, *for* became, *read*, becomes.
241, — 9 and 21, *for* cimiter, *read*, cimeter.
330, — 14, *for* confim, *read*, confirm.
357, — 4, *for* this, *read*, the.

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